The Chemical Age

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Contents

NOTICES:—All communications relating to editorial matter should be addressed to the Editor, who will be pleased to consider articles or contributions dealing with modern chemical developments or suggestions bearing upon the advancement of the chemical industry in this country. Communications relating to advertisements or general matters should be addressed to the Manager.

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Dyes and the Worsted Trade

A MEMBER of our technical staff who was recently travelling in Yorkshire relates that at one of the large northern hotels he unexpectedly got into conversation with an individual who proved to be one of the partners in a large and well-known firm dealing in the high-class worsted trade. After a time the conversation drifted on to the subject of dyes, and our representative naturally endeavoured to gain from a large consumer a frank opinion of the British progress in this direction. His informant explained that, in the first place, he could speak only for the highest class of the worsted industry, and that his remarks must not be taken as applicable to the immense business carried on in lower class materials. The opinions expressed were certainly candid, and we pass them on to our readers, not because we believe them to be altogether justified, but because criticism of the kind frequently brings out into the open small defects which would not otherwise be appreciated. The consumer in question spoke of the fact that in some instances (*e.g.*, blacks) the home-produced dyes were equal in quality to anything previously obtained from the Continent, but in many other cases he was only able to maintain the reputation of his goods by employing Swiss dyes. He spoke, moreover, of the exceptionally fair contracts which the Swiss producers had concluded with him during the war, and the businesslike manner in which they were still prepared to deal with him.

Perhaps, from the commercial standpoint, the most important point raised was that in connection with the main tests to which the dyes are subjected. For instance, no dye is considered suitable for the high-class trade unless its withstands the processes of "potting" and "milling," and possesses the quality of fastness to light. A purchaser, accordingly, when interviewing the representative of a dye manufacturing firm, primarily seeks an opinion as to the capability of any particular colour to meet these three conditions. Our informant spoke of the fact that the representatives of the German dye houses before the war not only knew the exact capabilities of their individual products, but they had a wide knowledge of the behaviour of the products of rival firms. Moreover, they had on occasion no hesitation in admitting that their dyes were not suitable for certain purposes. They would frequently recommend the product of another maker, and give detailed comparisons between the various manufactures. In contrast to this, we were told that, although the selling representatives of the English houses are full of enthusiasm for their wares, in their knowledge of the subject they are a little behind the representatives of the foreign firms. The result is that, instead of admitting that a dye is probably unsuitable for a certain purpose, they refuse to hear of its limitations, with the result that the purchaser is occasionally let down, and tends to become distrustful. As we have said above, we give this opinion merely as it has been given to us, feeling, perhaps, that our informant may probably have been influenced in some degree by the favourable manner in which he has evidently been served by the foreign houses.

Metallurgical Developments

THIS week's issue of THE CHEMICAL AGE is more or less of a metallurgical nature, which, perhaps, is quite appropriate in view of the important meeting of the Institute of Metals which was held at Barrow on Wednesday. Abstracts of the papers read at this meeting will be found elsewhere, as well as a comprehensive article on tungsten contributed by Mr. Julius Vogel. The history of tungsten production in this country during the past six years provides an interesting example of the ability of the British chemist, when circumstances demand, to embark upon and bring to a successful conclusion processes which have been more

or less the monopoly of other countries. Prior to the war the special variety of tungsten employed in the manufacture of steel was almost solely obtained from Germany, and in August, 1914, immediate steps had to be taken to meet the deficiency. Some thirty large steel makers combined to erect a factory for the production of tungsten powder; and, once the Government red tape was removed, the new source became so prolific that sufficient of the substance was provided to meet not only our own demands but those of our allies as well. Since the cessation of hostilities the new industry has been playing an important role in meeting the demand occasioned by reconstruction, but Continental competition is gradually beginning to make itself felt, so that the ability of the home industry to compete with outside producers has yet to be proved. Here again the gradually increasing scale of wages is giving rise to considerable apprehension, and it is to be feared that even the most favourable conditions of manufacture and sales cannot counterbalance the cost of labour to an unlimited extent. Apart from commercial considerations, however, we feel that those who worked on the tungsten problem performed a great national service. and the intricacy of the process, particularly in regard to the elimination of impurities in the final product, is well illustrated by the facts which Mr. Vogel brings out in his article.

As regards the papers read before the Institute of Metals that contributed by Professor H. C. H. Carpenter and Miss C. F. Elam will probably arouse most interest among our readers. Broadly, the paper deals with the changes which heat produces on worked metals, and the authors state that, if their conclusions stand the test of scientific criticism, existing theories of crystal growth and recrystallisation will have to be examined anew. Recrystallisation is said to have occurred when all trace of the old arrangement of crystals or groups of crystals has disappeared, whereas by crystal growth is meant that rearrangement which leads to an increase in crystal size. The authors of the paper have carried out a number of experiments to show the structural changes produced in a crystal aggregate by deformation of a strip of metal followed by heat. In the main they conclude that the largest crystals are always formed after the application of the minimum amount of stress sufficient to produce growth, and the lower the annealing temperature the greater will be the stress required to produce the large crystals. The paper is of a rather highly technical nature, but it is an admirable illustration of the developments which are constantly taking place in the science of metallurgy.

The American Dyes Question

REPORTS from the United States show that the opposition which certain senators offered to the Longworth Bill and the successful efforts they made to force its withdrawal, at least for a time, are having an adverse effect on their chances of returning to the Senate. The motives for their opposition to the measure are discussed with a frankness that would be impossible in this country, and it seems clear that a determined endeavour will now be made, at whatever cost, to prevent the recovery by Germany of a place in the American dye market. In preparation for a general revision of tariffs the United States Tariff Commission is now busily engaged in collecting data on all American industries. Schedule A of the tariff law will deal with chemicals, and in addition to the general revision of the tariff several measures, not the least important of which is the dye bill, are contemplated which will bear very directly on the interests of American chemical industry. The principle on which the agitation for safeguarding the newly-established dye industry of the United States is proceeding is that "against the German chemical industry the only protection is a greater American industry," and to secure this end no expense or effort is apparently to be spared. We have heard British merchants contrast very unfavourably the progress already made in the United States with the progress made in this country, and attribute it to the different line of policy followed by the American Government. There is, however, one point in common. Both Governments recognise that a home dye industry is essential to national safety; both are agreed that, whatever temporary disadvantages are necessary to attain this end, the price must be paid.

We shall probably be faced in this country with very much the same problem when the expected Imports Restriction Bill is introduced. The creation of a new power to prohibit imports of synthetic dyes and synthetic organic chemicals generally, subject to a system of licences, is from the Government side simply an executive measure for giving effect to a principle already deliberately adopted as the basis of national policy. Whether the particular form it takes is the best may be a matter of opinion. It is certain to be subjected to vigorous criticism from various angles. If the Government adhere to the scheme they are understood to have decided on they will certainly be well advised to make the most generous concession possible for the representation of all the interests concerned on the licensing authority. If this authority is of too restricted or too autocratic a character, if in addition it once gets suspected of being dominated by the manufacturing or any other sectional interest, it must provoke widespread dissatisfaction. If on the other hand everybody accepts it as fairly representative, then the inevitable inconveniences may at least be reduced to a minimum. More than that one can hardly expect. Merchants will be glad to hear that as regards licences for the export of dyes without manufacturers' certificates the tendency is rather to relax than to strengthen the existing regulations. This is a natural result of a rather more plentiful supply of dyes in the home market, which may be attributed largely to the slackening of business in the textile industry.

Chemistry and Industry

THE sixtieth general meeting of the American Chemical Society, which was held in Chicago last week, had for its slogan: "Increased production through chemistry," and the comprehensive list of papers read dealt with the scientific increase of production, the saving of labour by better engineering methods, the development of new sources of supplies, the further extension of by-product industries, and the chemical production of substitutes for raw materials. Incidentally it may be noted that at these American gatherings film pictures are freely used for the illustration of lectures, and represent a marked

advance on the lantern slides still used in this country. There is, of course, no reason why papers of a very high technical order should be cast in the most abstruse form possible. The American plan of making the results of scientific research as widely and as easily accessible to the public as possible is good from every point of view, especially from that of impressing the lay public with the importance of science and the directness of its bearing on industrial efficiency and progress.

Among the practical subjects down for discussion was one which the Society of Chemical Industry in this country has already solved. It appears that the American Chemical Society is feeling acutely the effect of the general increase of prices, and the only method of relief seems to be the advance of the members' subscription from ten to fifteen dollars. To each member who pays ten dollars for the current year it is stated that the Society will furnish publications costing at least $12·24 per member. Other activities of the society bring the total cost per member to $15·60. On this basis the proposal to increase the subscription to $15 does not strike one as extravagant. In any case it is necessary if the work of the Society is not to be seriously curtailed. What the policy of retrenchment would mean is put pointedly by *The Journal of Industrial and Engineering Chemistry*, which may, by the way, be congratulated on its enlarged and greatly improved form. "The policy of expansion," it says, "of this journal unanimously adopted in 1916 might be revoked; the A.C.S. News Service might be abolished just at the moment when it is proving beyond the shadow of a doubt that it is performing an essential function in the life of the Society and of the nation; the scope of *Chemical abstracts* might be narrowed; indeed, each item of the annual budget, always conservatively defined by the directors, might be contracted. But this is no time for retrenchment. The country is awakening as never before to the meaning of chemistry in everyday life; the capital invested in the chemical industries is far greater than at any period in our history; legislation, enacted and in the making, recognises the importance of chemistry as a national asset. Shall it be said that at this constructive period in the development of American chemistry the American Chemical Society has had to restrict its activities because of lack of funds?" By this time the agonising problem has probably been settled. Our American friends have risen in their might and declared that these calamities shall not befall the Society. At Newcastle the delegates did the same, only more quietly.

Professor Cobb's Ammonia Process

ALTHOUGH but little information is available on the subject, it is, of course, well known that Professor J. W. Cobb, of Leeds University, has for some time been experimenting with a new process for the recovery of the ammonia evolved from coal. The process was referred to by the chief inspector under the Alkali Act in his report for 1918, and in the 1919 report recently issued it is announced that a plant having a capacity of one ton of ammonium sulphate per day is now in operation. Briefly, it may be recalled that Professor Cobb has set out to accomplish in a simple manner what German chemists have done by introducing a series of complications. The principle involved is that of effecting combination between ammonia and sulphuretted hydrogen, thus producing the sulphate without the employment of sulphuric acid. We are now told that the Cobb process has proved itself in operation to be technically successful, and the original plant is undergoing modification for the purpose of securing greater commercial efficiency as regards working costs. The process consists in washing crude coal gas with a solution of zinc sulphate which, after performing its function, is regenerated for further use. The first reaction produces sulphate and zinc sulphide, the former being filtered out and recovered by evaporation, while the precipitate of the latter is roasted, yielding zinc oxide and sulphur dioxide. The roaster gases are finally blown through water containing in suspension the zinc oxide from a previous roasting, zinc sulphate (ready again for the preliminary washing process) resulting from the operation. Professor Cobb is certainly to be congratulated upon having devised a process which is simplicity itself in comparison with methods for arriving at the same end which have been evolved in Germany. Comparison, for instance, may be made with the latest Feld process which employs polythionate salts as the purifying medium. Originally Feld employed an iron salt in much the same way as Cobb now uses zinc, but difficulties arose owing to the considerable dissociation of sulphites, and the method was abandoned in favour of one based upon the oxidation of thionates. The crude coal gas is washed with a solution of ammonium tetrathionate, which is converted into ammonium thiosulphate and trithionate. The latter liquor is then treated with a current of sulphur dioxide, when the thiosulphate and trithionate are regenerated into tetrathionate. When the tetrathionate liquor becomes sufficiently concentrated it is decomposed by heat, with the formation of sulphate of ammonia, free sulphur and sulphur dioxide. The two last-named are then made use of again in the earlier stages of the process. In spite, however, of the way in which the method has been scientifically perfected, it has, as might be expected, proved too cumbersome in practice.

The Calendar

Sept. 21–24	Iron and Steel Institute: General Meeting.	Cardiff.
22	Institution of Petroleum Technologists: "Utilisation of Heavy Oils," by Professor J. S. S. Brame. 6 p.m.	Canada Building, Crystal Palace, London.
Oct. 1	Society of Chemical Industry (Manchester Section): "The Structure of the Molecule in Crystalline Solids," by Professor W. L. Bragg. 7 p.m.	Grand Hotel, Manchester.
18	Physical Society of London and Faraday Society (Joint Meeting): "The Physics and Chemistry of Colloids."	London.
18	Royal Automobile Club: "Alcohol Motor Fuel," by Professor H. B. Dixon. 9 p.m.	Great Gallery, Royal Automobile Club, Pall Mall, London.
19	Hull Chemical and Engineering Society: "The Chemistry of Foods" (Part II.), by A. R. Tankard. 7.30 p.m.	Victoria Room, The Metropole, West Street, Hull.

Tungsten

By Julius L. F. Vogel, M.I.E.E., M.I.M.M.

A FEW years ago a Paper on Tungsten might have contained information that was new to many chemists, and so far as concerns the general public the very existence of such a metal was then almost unknown. A great deal has been published on the subject, however, since this country was rudely awakened to the fact that an essential in the manufacture of munitions had hitherto been purchased from abroad, and almost entirely from Germany. At the same time there are probably many technical men who have had no occasion to study the literature of this specialised industry, and it would be best, I think, for me to outline briefly the origin, method of manufacture, and uses of tungsten, before dealing with a few points which may be less generally known.

Wolfram

The minerals of tungsten from which the metal is obtained commercially may be divided roughly into two general classes, wolfram and scheelite.

Wolfram is used loosely to cover all of those minerals in which tungsten trioxide is combined with the protoxides of iron and manganese. There are found minerals of this class in which the ratio of the iron and manganese varies widely and special names have been given to certain minerals in which one or other of these elements predominates to a marked extent. These differences, however, have little or no bearing on the value or treatment of the minerals for making pure tungsten, though for ferro tungsten, the manganese contents must be watched carefully, as buyers of ferro tungsten specify limits for manganese which must not be exceeded.

Wolfram ores are found for the most part in close proximity to or mixed with tin ores, and geological formations favourable to either mineral should be carefully examined for both. A great deal of study has been given to the geological data afforded by the opening up of fresh wolfram fields to determine the relative age of deposition of the tin and tungsten minerals, and there is evidence that in mixed deposits the wolfram zone will overlie the tin, and passing through a mixed zone will tend at depth to yield tin free, or almost free, from wolfram.

In appearance wolfram is a black, easily friable mineral with a pronounced cleavage. It has a brown streak, and when subject to vibration in transport it assumes a rusty appearance through the particles rubbing against one another. It is noticeable for its great weight, the specific gravity of the pure mineral being as high as 7·0, and for this reason concentrates free from silica, and other gangue can be prepared either by hand or mechanical washing. Tin oxide, *i.e.*, cassiterite, when present cannot be separated in this way, but wolfram is feebly magnetic while cassiertite is non-magnetic, and these properties are utilised to effect separation of the two minerals if and when they are both present in a concentrate. Attempts have been made to effect separation of cassiterite and wolfram by heating, when the wolfram decrepitates to a considerable extent, and on screening is found concentrated in the fines. This method is, however, of no commercial importance since the separation is not complete.

Scheelite

The second mineral in common use is scheelite, in which tungsten trioxide is in combination with calcium oxide. This is also a very heavy mineral of an opaque wax-like appearance, varying in colour from the palest yellow to brown and sometimes purple. The quantity of scheelite mined is small, as compared with the amount of wolfram, and it finds its outlet mainly in the manufacture of ferro tungsten, since for certain reasons to which reference is made later, there are considerable difficulties encountered in isolating WO_3 from scheelite to make pure tungsten metal. A further trouble with scheelite is due to its being non-magnetic, and, therefore, not separable from tin oxide in the same way as wolfram.

The sources of supply of wolfram and scheelite have extended considerably in the past few years through the urgent demand for tungsten during the war. Supplies have been obtained for many years in varying quantities from U.S.A., Bolivia, Portugal, Burma, Malaya, Australia, New Zealand, and Cornwall. In most cases the war demand was met by increased supplies from these countries, but in addition a very big tonnage was forthcoming from China, where several virgin deposits were discovered, and South America, Japan and other countries became regular producers.

The bulk of the world's supply of tungsten ores has been obtained from alluvial deposits or lode formations where the rock has weathered and left the formation in sufficiently soft condition to be cut down by sluicing or hydraulic nozzles. For this reason a newly discovered field will produce for a time large quantities of easily and cheaply won product, and it is a matter of extreme difficulty to forecast outputs and values of these minerals. Further, even the highest production (in 1918 and 1919) did not exceed some 30,000 tons of concentrates for the whole world, and a commodity whose consumption is comparatively small naturally fluctuates very widely in price, according to supply and demand.

True alluvial deposits of tungsten ores caused by the breaking down of lodes by natural forces, with long transport by gravity from elevated to low-lying ground, can hardly be said to exist. The tungsten minerals will not stand this treatment, as they are disintegrated through their friability, and decomposed by the vegetable acids due to decaying vegetation. Where tin flats are discovered containing finely divided cassiterite spread over wide areas, the original lodes may be traceable on high ground many miles away, but even if these lodes also contain wolfram the alluvial will be almost entirely free from this mineral. Where detrital deposits of wolfram are found, lodes will be discovered as a rule near by, and frequently what is described as alluvial wolfram is really a number of decomposed lodes or stockwork *in situ* containing the wolfram, which is undisturbed and thus protected from destruction.

Tungsten Alloy Steel

Before discussing the method of converting the tungsten trioxide in the minerals into metallic form, it is perhaps better to consider the uses to which the metal is put.

There is a demand for tungsten metal, tungstic acid and sodium tungstate for various minor industries, but the consumption for these is negligible in comparison with the quantity employed in the manufacture of tungsten alloy steel. Steel of this class is produced with its tungsten contents varying from 2 to 3 per cent. to 18 to 20 per cent., and the tonnage consumed by high speed steel makers who produce this class of steel, absorbs probably 95 per cent. and upwards of the total output of tungsten-bearing ores. The properties of tungsten steel depend not only on the presence of tungsten and other ingredients in addition to the iron, all in carefully regulated proportions, but also on the absence of certain deleterious impurities. It is essential, therefore, in selecting the materials from which such steels are made to avoid the introduction of these impurities in amounts which collectively will exceed the danger mark. Further, the composition of high-speed steel calls for low carbon contents, and this entails a low percentage of carbon in the tungsten.

In purchasing tungsten for such purposes steel makers stipulate for freedom from impurities, and especially from those which may be introduced also in the other ingredients, as, for instance, phosphorus and sulphur. Of the impurities likely to be present in wolfram or scheelite, and to be eliminated in preparing tungsten, there are tin, manganese, copper, arsenic, lime and silicon. Very pure wolfram containing more iron than manganese and free from the above mentioned impurities, by direct reduction, yields a ferro tungsten of suitable quality for most purposes, provided the carbon and silicon are kept low. The success of this, however, depends obviously on the utilisation of very pure wolfram, either from an exceptionally good deposit or after subjection to careful roasting, magnetic separation, and dressing. Experience shows that even with the greatest care the resulting ferro tungsten is liable to contain dangerously high percentage of one or more impurity, and for those tungsten steels containing 18 to 20 per cent. tungsten the impurities introduced with the ferro tungsten may easily exceed the desired specification.

Hence arose a demand for tungsten manufactured from

tungsten trioxide which had been freed from impurity prior to reduction to metal. The Germans tackled this problem initially, and, following closely laboratory practice, put on the market 96 to 98 per cent. tungsten metal powder low in carbon, and this was in pre-war days the standard product employed in the manufacture of high-speed steel. The method employed was to melt the ore with an alkaline carbonate, whereby the tungsten trioxide is attacked and forms tungstate of soda, an easily soluble salt. Iron, manganese, copper, tin, and silica remain unattacked if the melting is carried out skilfully, and by solution and filtration the sodium tungstate is separated and ready for production of WO_3. Sulphur, in the form of alkaline sulphate, and arsenic, and phosphorus will all be carried forward in the sodium tungstate solution, and therefore should be eliminated before melting by calcination or other treatment of the wolfram.

The tungstate of soda treated with hydrochloric acid yields tungstic acid and sodium chloride. Sodium chloride is, of course, soluble, and remains in solution whilst tungstic acid is essentially insoluble, though under certain conditions referred to later, the percentage of soluble tungstic acid liable to be lost is high. After washing free from sodium chloride the tungstic acid is dried and calcined to remove combined water, leaving tungsten trioxide in the form of a pale yellow powder. The reduction of this to metal can be effected by carbon, hydrogen, aluminium, zinc, or other reducing agents at a suitable temperature, but not high enough to melt the tungsten, which remains in powdered form, and in this form it is used to prepare tungsten alloy steel in crucibles or electric furnaces.

From this brief outline of the process of manufacture it will be realised that the problem is one of converting a laboratory method into a commercial process, by designing suitable plant for every operation, and by arranging for complete checks by assay at every stage of the operations. I will now deal with certain points in detail.

Ferro Tungsten

The direct reduction of wolfram requires a high temperature such as is obtainable only in an electric furnace, or by the use of aluminium, silicon, or other highly active reducing agent. The operation involves the formation of a suitable slag, and from this point of view the addition of a certain amount of scheelite to the wolfram is advantageous as the lime helps in the slag. Further, the percentage of aluminium is reduced if scheelite is employed, and the percentage of tungsten in the ferro tungsten is raised. The electric furnace reduction is complicated by the tendency to form high carbon ferro tungsten, through the formation of tungsten carbide. Details of the methods of manufacture of ferro tungsten are not published, and vary considerably in different factories. Apart from the production of a high grade product the yield of tungsten for mineral employed is the most important point, since costs rise rapidly if losses are not kept low.

By the aluminium reduction process a yield of nearly 95 per cent. is obtained under the best conditions, which include the treatment of large charges, as in all thermo reduction processes efficiency undoubtedly varies directly with the quantity treated in an operation. The slags from the aluminium reduction have some value as abrasives, and the plant and apparatus required are essentially simple and comparatively inexpensive. Further, the stand-by charges in slack times are low since there is little to get out of order, and no continuously moving plant. The tungsten contents of properly made ferro tungsten exceds 80 per cent., and this approaches the highest percentage possible to melt into the form of a solid alloy.

A few typical assays of high-grade ferro tungsten are given below, and for the sake of comparison all assays are grouped together.

It is claimed for ferro tungsten in comparison with tungsten metal powder that when added to molten steel, especially in electric furnaces, the alloy melts more easily and with less loss of tungsten. On this question I am not qualified to give an opinion, and I can only say that one of the most expert and experienced high-speed steel makers has informed me more than once that he can obtain better results by using tungsten metal powder in electric furnaces than by using ferro tungsten.

Tungsten Metal Powder

Turning now to the preparation of tungsten metal powder, as previously mentioned, this involves initially the isolation of tungstic acid from the other constituents of the minerals. Both wolfram and scheelite are split up by either mineral acids or fused alkali, and both alternative methods are employed. As is always the case there are pros and cons on both sides. By acid attack it is sought to dissolve out the iron, manganese, and other metallic oxides, leaving the WO_3 as an insoluble residue. To complete the operation very fine grinding is essential and prolonged digestion with heat. By employing sulphuric acid the tungstic acid residue requires most elaborate washing to remove all the sulphur, since this is liable to remain in the reduced metal. With hydrochloric acid the solution is slow, and in fact on a commercial scale, the difficulty of obtaining complete decomposition with any mineral acid is pronounced, as the mineral and tungstic acid residue are both extremely heavy and require elaborate stirring appliances to prevent packing. While lead-lined vessels can be used for vitriol, great difficulty is experienced in constructing large tanks and stirrers to resist hot hydrochloric acid. Further, the mineral must be extremely pure, as any silica, tin oxide and other gangue remains insoluble and contaminates the tungstic acid.

Typical Analyses

	Tungsten W.	Carbon C.	Silicon Si.	Manganese Mn.	Copper Cu.	Tin Sn.	Sulphur S.	Phosphorus P.	Lime CaO.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Electric furnace ferro tungsten. Co. A.	84·50	1·00	0·22	0·67	0·02	0·14	0·03	0·02	Nil.
Electric furnace ferro tungsten. Co. B.	83·00	0·30	0·80	0·45	0·10	0·15	0·05	0·04	0·05
Ferro tungsten, presumably made by Aluminium Reduction	85·46	0·05	1·22	0·46	0·08	0·17	0·01	0·03	0·02
Standard Specification for ferro tungsten, 1917	75/85	1·00	1·00	1·00	0·05	0·25	0·06	0·025	0·03

Items other than W maximum permissible.

TUNGSTEN POWDERS.

Tungsten powder, Co. C. ...	98·02	0·15	0·31	0·02	Nil.	Nil.	0·07	0·028	0·20
Tungsten powder, Co. D. ...	98·62	0·10	0·15	Trace	Nil.	Nil.	0·06	0·005	0·02
Standard specification for tungsten powder, 1917 ...	96/98	0·50	0·30	0·20	Nil.	Nil.	0.05	0.015	Nil.

Items other than W maximum permissible.

TUNGSTEN ORES.

	Tungstic oxide, WO .	Ferrous oxide, FeO.	Manganese oxide, MnO.	Ferric oxide, Fe_2O.	Silica. SiO_2	Tin oxide, SnO_2.	Lime, CaO.	Sulphur, S.	Arsenic, As.
Wolfram	70·30	16·30	6·60	1·42	2·90	0·95	0·18	0·06	0·04
Scheelite	74·00	0·84	0·54	0·92	4·71	0·15	18·50	0·10	0·05

As regards efficiency, difficulty is experienced through some of the tungsten being soluble. The extent of solubility of pure WO_3 in acid is not altogether a guide to commercial operations, as unfortunately these can never be carried out with pure laboratory materials, and on large scale working with even the best commercial raw materials complex conditions arise. For instance, tungstic acid becomes colloidal and the presence of certain impurities such as arsenic tend to the formation of complex tungstic acids, which are readily soluble. Assuming, however, a satisfactory decomposition and yield of WO_3, the purity of the WO_3 through insoluble residues will be too low to ensure high-grade tungsten powder on reduction. These insoluble residues may be separated by solution of the WO_3 in ammonia filtration and re-precipitation of the WO_3, but the cost of this operation is prohibitive. It may be stated, therefore, that except possibly on a small scale under exceptional conditions, wolfram ores are not treated commercially by acid attack.

As regards scheelite, the proposition is rather different. Unless tin is present scheelite as a rule is found to be very pure, and it is mainly a question of dealing with tungstic acid and lime. Obviously vitriol with the formation of sparingly soluble sulphate of lime is impossible, and hydrochloric acid is the alternative. Even with very fine grindings and prolonged digestion the decomposition of scheelite is sufficiently incomplete on a large scale to yield tungstic acid free from lime. Steel makers will not accept metal containing more than a very small decimal of a per cent of this impurity. Further, the solubility of some of the tungstic acid involves complications, since it is difficult to recover this from the calcium chloride solutions.

The Alternative Treatment

The alternative treatment of wolfram by furnacing with soda ash is a straightforward operation, and if the proper attention is paid to the temperature and rabbling uniform efficiency is obtainable. In the case of scheelite, however, melting with alkaline carbonate is by no means efficient, since the reaction is partially reversible, the sodium tungstate reacting on the calcium oxide with the reformation of calcium tungstate and caustic alkali. Various devices have to be adopted to yield an extraction of WO_3 from scheelite equal to that easily obtainable from wolfram, but the cost of treatment is much higher. For the manufacture of tungsten metal powder therefore, scheelite is not employed to a large extent. Its use, as previously mentioned, in the manufacture of ferro tungsten is sufficient to absorb supplies more or less in the relative proportions in which it is mined, in comparison with wolfram.

The solution of the tungstate of soda made from wolfram, and its separation by filtration from the oxides of iron, manganese, silica, &c., are straightforward operations. The precipitation of the tungstic acid from the sodium tungstate, however, presents various difficulties. With dilute solutions of sodium tungstate and dilute acid in the cold, the white modification of tungstic acid is obtained, but a considerable proportion of the tungsten may remain in colloidal or other solution. Further, the precipitate that is formed remains in suspension for an indefinite period, and it is impossible to wash it free from soda salts.

Going to the other extreme, the solution of sodium tungstate may be evaporated to yield crystaline sodium tungstate, which, added to boiling hydrochloric acid, yields a dense easily settling tungstic acid. It is difficult, however, to ensure the decomposition of all the sodium tungstate, and to avoid the formation of an insoluble acid sodium tungstate from which the soda cannot be removed by washing. From the mechanical point of view the usual difficulty of apparatus to stand boiling hydrochloric acid has to be met, and stirring gear is a special difficulty. In any case, whether from solutions or from the solid powdered salt, the sodium chloride solution will always contain some dissolved tungsten, and this increases rapidly if arsenic is present.

The importance of freedom from arsenic or elements forming complex acid with WO_3 may be gauged from the fact that for every pound of As_2O_3 present in the mixed acid and tungsten solution, approximately 10 lbs. of tungstic acid remains in solution. The tungstic acid, after washing by decantation or after filtration, must be dried and dehydrated. This requires heat to some 300°C. to 400°C., and contact with free gases must be avoided, as otherwise sulphur is sure to be absorbed by the WO_3. The reduction of the WO_3 to metal is purely a question of heat and any suitable reducing agent such as hydrogen, charcoal or hydrocarbon gas. Zinc may be used, but this involves solution of the zinc oxide, and it is not commercially efficient.

One point to be borne in mind is that when using a solid reducing agent such as charcoal, very intimate mixture is essential, since an excess of carbon must be avoided if the finished metal is not to exceed 0·25 per cent. carbon, which is the usual specification. For carbon reduction crucibles are employed, and the design of crucible furnaces is different probably in every tungsten factory. The essentials are a slow preheating from cold to the maximum of about 1,000°C., and a slow cooling to a black heat before removal to where there is free access of air.

The Need of Technical Control.

To chemists it is hardly necessary to point out that the various steps involved in such an industry as this require the most careful technical control. Ore supplies vary very considerably in quality, and in consequence all reagents have to be adjusted from day to day to ensure the proper proportions. There is no road to this save through the laboratory, and the routine work of testing intermediate products for efficiency of reaction and yield involves hundreds of determinations every week. At the same time, as in every healthy industry, progress is essential to efficiency, and investigation into major or minor improvements of process and plant occupies the time of quite a considerable staff, both of chemists and chemical engineers. The close contact of the laboratory and the factory involves the necessity of employing a number of trained chemists who are, at any rate, familiar with a variety of plant, and are tactful in dealing with foremen and labour.

It is altogether to the credit of the workmen to find how quickly they respond to the rulings of the technical staff when the right men are selected for supervision of the process. It is not a case of an engineer's shop where numbers of different parts are made to gauge and collected for erection, and a defective part can be replaced with a comparatively small loss. In a metallurgical chemical works where the raw material passes continuously through a number of processes before the finished product is obtained, defective work in any one department may affect the whole output of the factory adversely, and in extreme cases bring about a complete stoppage.

There is a tendency to regard Germany as the only place where the laboratory has been translated into the factory successfully, and it is often stated that the discipline instilled into German workmen by military training is essential for such operations. Our experience, on the contrary, is that the majority of British workmen will carry out their jobs, under judicious instruction and supervision, quite satisfactorily, and that frequently their intelligent interest will assist in the introduction of improved methods of working or handling materials.

One of the greatest troubles to be guarded against is the concealment of mistakes which may have resulted in loss of material or other additional cost. Too much emphasis cannot be laid on the importance of making everyone understand that he is known to be only human and, therefore, liable to error, and that the management is equally liable to make mistakes. By instilling into the staff the knowledge that men's mistakes will not be regarded as culpable, unless there is direct evidence in proof of intent or gross disobedience, and by insisting on the fact that concealment of a mistake is worse than the mistake itself, a very much improved morale is established.

In conclusion it may be of interest to touch upon the condition of the tungsten industry in this country. In August, 1914, as soon as the serious shortage of tungsten was realised by high-speed steel makers, and the Government steps were taken to make good the deficiency—the Government intimated its willingness to participate in the erection of a factory, if the consumers would organise a suitable scheme. Eventually direct participation by the Government was found to involve too much red tape for commercial possibilities, and some thirty large steel makers combined to erect a tungsten powder factory; Eight private firms also started to make either powder or ferro tungsten.

As the demand became very great, and ore supplies were limited, the Government in 1915 took control of the whole industry by commandeering ore supplies, allocating ore to the different smelters, and fixing prices both for ore and finished products. By these means a restricted, though just sufficient supply of tungsten was maintained for the national and allied requirements up to the date of the Russian collapse, when the supply gradually overtook and exceeded the demand.

The armistice found here and in America large stocks of wolfram, and in addition large commitments by the British Government to purchase further supplies, as and when mined. The inevitable laws of demand and supply controlled the situation, despite vigorous attempts to create an artificial situation, and prices for wolfram and tungsten fell to about half those ruling under the Government control. This resulted in a steadily improved demand, as the world's stocks of high-speed steel had been depleted during the war, and the requirements for reconstruction and engineering became evident. In this post-war demand for tungsten, the war-time factories in England have played and are playing an important part. Gradually Continental competition is making itself felt, and the real test as to the permanency of the industry in this country on its own merits has still to be made.

From this point of view the costs of manufacture naturally are all important. These in the case of tungsten powder may be classified as follows: Raw material, labour, fuel, chemicals, &c. Naturally, with a fall in value of raw material, the percentage cost of the other items, as compared with the total cost, must rise.

A true comparison, therefore, can only be made by estimating costs per ton of finished metal produced.

RATIO OF COSTS OF MANUFACTURE.

	Labour.	Fuel.	Chemicals and General.
1916 ...	100	100	100
1917 ...	112	81	107
1918 ...	160	92	124
1919 ...	180	124	126
1920 ... (6 months)	157	100	—

The above figures must be studied in conjunction with certain information. The cost of labour shows a continuous rise until 1920, but the output, while fairly uniform in the first four years, was approximately doubled in the last period. Failing the increase of output in 1920 the wages would have been more than double those paid in 1916. The fuel cost represents the results of improved methods of manufacture and reduced consumption, and although the quantity employed per ton of finished metal has been more than halved, the cost remains stationary as compared with 1916.

Pages of figures would be required to show clearly the additional cost due to the increased price and inferior quality of the fuel, as the latter reacts on the labour employed, on the cost of carting clinker and ashes, and on the upkeep of furnaces. As regards chemicals and general expenses, these have risen steadily, many chemicals costing three or four times their pre-war prices. These figures clearly indicate that technical improvements of the greatest value have been more than counterbalanced by the increased costs of materials and labour.

The moral is not in any way obscure. Given an open market in which to purchase the basis raw material open to foreign competitors as well as to manufacturers in this country, sooner or later costs may become prohibitive unless there is a check in the rising scale. The most favourable conditions of manufacture, freight and sales, cannot counterbalance cost of labour to an unlimited extent, and unless this fact is recognised and acted upon, the industry cannot become permanent in the country, despite its successful inception under the difficulties of war conditions. It must be borne in mind that the technical success of scientific investigation sooner or later must be tested by commercial application, and it will lead inevitably to discouragement and apathy to find that even established technical industries cannot be made to pay in this country. I have sufficient faith in the innate common sense of the British workman to believe that he will not kill the goose that lays the golden eggs, provided he feels that he is on a square deal. It remains then to convince him that this is the case, and that his efforts will be rewarded with a wage adequate for his requirements.

A Key Industry

Assuming that production costs will be established on a reasonable basis of output and wages, the industry must sooner or later face foreign competition. On the recommendation of the Engineering Committee and Lord Balfour of Burleigh's Committee, the manufacturers of tungsten and ferro tungsten was included in the key industries, the protection of which was recognised by the Government as essential when the lesson of 1914 was fresh in their minds. Legislation, however, has been postponed or abandoned, but even the recognition and protection of certain key industries does not altogether afford a safeguard against the indirect results of dumping on the chemical industry. If dumping of certain chemicals from abroad is not restrained, manufacturers at home may have to stop production and simultaneously cease to produce other bye-product chemicals required for subsidiary industries. For instance, unless there is a market for home-produced salt-cake, hydrochloric acid must cost a prohibitive figure to produce. Thus the cost of tungsten manufacture must increase. There is nothing to-day to prevent the import of German-made tungsten produced by cheap labour, and quite possibly sold at little profit or even at loss, in an attempt by the Germans to regain a lost monopoly. To meet this competition, I think an industry of this importance has a right to such protection as is necessary against unfair competition, if and when this is organised and put in force.

German Dyestuffs

IN connection with an issue of £1,500,000 4½ per cent. notes now being made by the Farbewerke vorm. Meister Lucius & Brüning, Höchst, German dyestuff manufacturers, the firm have issued a statement, in which it is mentioned that the money is required in order to finance the firm's projects for re-establishing their foreign trade, to enable them to complete the turnover from war to peace work, and to proceed with their schemes for the production of nitrogeneous fertilisers from the air. It is stated that, owing to the great economic changes which have taken place since the cessation of hostilities, the special privileges granted to certain members of the German Dyestuff Kartel in connection with the manufacture of certain products have been withdrawn.

With regard to the company's foreign activities it is mentioned that the English branch has been liquidated, that, in accordance with the terms of the Peace Treaty, the French branch will no doubt be liquidated shortly, and that the works at Moscow have been socialised and, according to the latest reports, were producing dyestuffs on a small scale.

A brief reference is made to the company's holdings in outside firms, these including almost the whole of the shares in the aniline colour firm of Kalle & Co., Biebrich (£300,000), shares to the nominal value of £1,500,000 in the large colour makers, L. Cassella & Co., the majority of the shares in the Knapsack Nitrogen Fertiliser Co. (capital £400,000), and the greater part of the capital (£75,000) in the China Import, Export & Bank Co., Hamburg. Before the war, the last-mentioned undertaking paid dividends of 150 per cent. per annum, but it has paid nothing since 1917, when the distribution was 12 per cent.

Sir John Cass Technical Institute

On Monday, September 27, the new session of the SIR JOHN CASS TECHNICAL INSTITUTE will begin. The courses of instruction provided are especially directed to the technical training of those engaged in chemical, metallurgical and electrical industries, and in associated trades. Special courses of higher technological instruction form a distinctive feature of the work of the Institute. The curriculum in connection with the fermentation industries includes courses of instruction in brewing and malting; in the history, cultivation and use of the hop; and in the micro-biology of the fermentation industries. These courses are arranged for those engaged in the practical and scientific control of breweries, maltings and other fermentation industries who desire to acquire a knowledge of the technology and principles underlying their daily operations. A connected series of lectures on fuel and power is also included in the syllabus of the chemistry department for the forthcoming session. In the department of physics and mathematics special courses of lectures will be given in colloids, the methods employed in their investigation, and their relation to technical problems.

Chemical Aspects of Oil Refining

Lecture by Dr. A. E. Dunstan

THE series of free illustrated lectures arranged by the Institution of Petroleum Technologists was continued on Wednesday, September 8, in the Canada Building, Crystal Palace, when Dr. A. E. Dunstan gave a lecture on "Petroleum Refining." There was a very large audience.

Dr. Dunstan remarked that in the previous lectures the origin of oil, prospecting for oil, oil geology, and the transport and storage of oil, had been briefly described, and it now fell to the lot of the chemist to deal with the refining of oil. He then briefly described the composition of mineral oil petroleum. Broadly speaking, petroleum from all fields consisted almost entirely of hydrocarbons. On an average, about 98 per cent. of the mineral oil was hydrocarbon in nature, together with compounds (which were usually regarded as impurities) of oxygen, nitrogen and sulphur. He had with him six analyses which illustrated how oil from different localities differed. From Pennsylvania one got an analysis as follows: carbon 86·1, hydrogen 13·9; from Californian crude, carbon 84, hydrogen 12·7, sulphur 0·75, nitrogen 1·7 and oxygen 1·2; from Mexican, carbon 83·7, hydrogen 10·2, sulphur 4·15; from Persian crude, carbon 85·4, hydrogen 12·7, sulphur 1·06; from Burma, carbon 83·8, hydrogen 13·0. (The carbon plus hydrogen added up to 96·8, so there was a gap of 3·2, which was mainly oxygen—rather a rare phenomenon.) The analysis of Taracan oil was: carbon 88·1 and hydrogen 11·9. It had been rather aptly pointed out that although mineral oils from various districts apparently varied so much, yet in reality they all contained the same series of hydrocarbons; they differed merely in the relative proportions of the members of the various series.

With regard to the sulphur, nitrogen and oxygen compounds, the sulphur compounds could be more particularly regarded as highly objectionable impurities, in that much of modern refining consisted in the elimination of sulphur and its compounds—to a certain extent from practical reasons, but perhaps to a larger extent from merely æsthetic reasons, in that the population at large had not been educated to the smell of sulphur derivatives.

Petroleum before being passed on to the distributor had to be refined, firstly, because it was an exceedingly complex mixture of a vast number of substances which were more conveniently utilised if they were broken up into groups of varying volatility: and, secondly, to remove impurities, colour and smell.

Types of Stills

The first operation in refining was generally distillation. The original distillation plant had been an ordinary boiler in which the oil had been evaporated, the first fractions taken off, and, in turn, the intermediate and heavier fractions. Obviously, from the point of view of fuel economy, boiling oil in a discontinuous way like that was not advisable, and the outstanding tendency in recent years in all refineries had been to economise fuel. Therefore, the simple pot or boiler still had very soon given way to a continuous process in which the various stills in a series were maintained at approximately constant temperatures, and which would run for months without any serious attention. The pioneer in that direction had been a Scotchman, Mr. Norman Henderson, and Henderson's benches of stills were familiar objects of the country-side in all oil refining districts. The stills consisted of a range of boilers, of about 30 ft. by 10 ft. Those boilers were set in fire-brick settings, heated underneath with oil fires, and heated internally by a current of live steam. The oil entered at one end of the still; flowed to the other end; from thence it dropped to the next member of series a little lower in height; from thence to the next still, and so forth.

A further refinement on the Henderson still consisted of a pretty obvious thing. The residue flowing out of the end of the last member of series was hot. That amount of heat thus flowing away could be utilised if it met in counter current the crude oil coming into No. 1 still. Therefore, heat interchangers were gradually evolved. Similarly, the vapours passing off from each still had to be condensed, and the latent heat of the vapours could very well be used to heat up the oil still further.

A further modification of the continuous Henderson benches of stills was the addition to each member of the series of a fractionating column. Normally the various fractions as they came off from the crude bench were not quite sharp. For example, the petrol fraction contained too much heavy boiling material, and the kerosene too much volatile material. These various fractions were re-distilled, involving transport from one still to another, extra firing, and loss of fuel energy. The tendency had been to try to carry out that sort of operation in one stage, so that one bench of stills would provide finished products. If each of the stills were topped with a fractionating column that end could be achieved.

Similar considerations had led to the development in California of the plant associated with the name of Trumble, which consisted of a very elaborate series of heat interchangers. In place of boiling several tons of oil in a big boiler, Trumble heated up his oil in a tubular furnace. The oil dropped down a tower where, by means of distributors, it was brought into contact with the hot sides of the column still, and so gave a film evaporation. The coal tar people had been more or less familiar with the tubular retort still for the last 30 years. Coal tar distillers originally distilled their tar in pot stills discontinuously, but Lennard, many years ago, put up a continuous still (which was working at the present time at the South Metropolitan works at Greenwich), in which he heated the tar not in a big boiler but in an ordinary cast-iron coil under about 60 lbs. pressure. He blew out the hot tar still under pressure into a series of columns. In number one he deposited his heavy substance; in number two he deposited the still lighter stuff, and so on, until he got down to the number four or number five column with light naphtha. The Beckton works, under direction of the late Colonel Wilton, also had a continuous tubular still of that sort running for dehydrating tar, consisting of a cast-iron coil in which the tar was heated and blown into a column. So that the idea of continuous distillation in tubular stills really went back to the coal tar technologists.

Quite a recent modification of stills was that by Mr. Hugh Allan, the General Manager of the Burma Oil Company's refinery. In Mr. Allan's system the oil was vaporised in the ordinary kind of Henderson still, but in place of being subsequently re-distilled, or in place of being collected via a column, Allan blew his vapours into a series of vertical pipes, in which he got the same kind of thing which Lennard had obtained in his tar still; that was to say there was a fractional condensation from member to member, the latent heat of the high boiling components being used to re-evaporate any condensed volatile oil. The net result was that one obtained any fractions desired.

Fractions Produced in Distillation

Dr. Dunstan then dealt with the various fractions produced in the distillation. First of all there was benzine. Benzine had to conform to certain final boiling points which depended on the efficacy or the want of efficacy of the modern carburettor. He remembered years ago being able to buy petrol at a gravity of about 690 for 9d. a gallon. It was a very different state of affairs to-day, and he thought it was fair to predict that in the near future engineers would devise their carburettors and internal combustion engines to take very much heavier benzine, because it was certain that if the present specifications, wide as they were, were perpetuated, petrol would be seen at 10s. a gallon in the not very distant future.

The benzine produced from many crudes required no chemical treatment; that was to say, on re-distillation benzine was fit for the market. Other crudes, particularly those containing sulphur, required treatment. The original treatment was to wash as drastically as possible the unfortunate spirit with an excess of strong sulphuric acid, followed up with soda, which was a wasteful process for two reasons; firstly, the acid was never really entirely recoverable, and, secondly, there were serious losses in the oil. The days of the acid treatment certainly should be doomed. In place of acid for removing sulphur bodies, there had been a great variety of substances proposed, mainly oxidising agents. A well-known

redel-action was that which depended on the effect of a solution of litharge in caustic soda. The sulphur derivatives could also be oxidised by potassium permanganate, bleaching powder, and a number of similar agents.

The next fraction came in between benzine and kerosene, and was alluded to as white spirit. The distillation and the refining of it followed the same procedure as benzine. The succeeding fraction was kerosene. The kerosene fraction was usually re-distilled, and the refining followed on similar lines to that of benzine. Two other general methods were mentioned which had not been dealt with under the head of benzine. The first was the Frash process. Frash boiled his fraction of oil with copper oxide, and he maintained the chemistry of the process was that the copper oxide dissolved in the sulphur compounds and formed a loose combination of sulphur compounds, and that this, in the presence of further copper oxide, deposited copper sulphide. The proportions he used were about 0·3 per cent. by weight of copper oxide.

The second method was an indication of the kind of refining method which would hold good in the future; that was to say, not chemical but physical-chemical. He was referring more particularly to the action of things like bauxite and Fuller's earth on oil and its distillates. Some curious happenings took place when a mineral oil was allowed to filter through Fuller's earth or bauxite, particularly when those substances were freshly ignited, being presumably colloids, and possessing a particularly active surface after ignition.

One colloid had the peculiar property of adsorbing or attaching to itself on the surface other colloids; but as well as adsorbing colloids they also adsorbed other things. Sulphur compounds in particular were adsorbed on to the bauxite and Fuller's earth, so that if one merely put distilled kerosene through a column of freshly heated bauxite, a filtrate was obtained which was practically entirely free from sulphur. One had had no chemical re-agent there. The spent bauxite could be re-heated and made ready for use again, merely mechanical losses having to be taken into account.

Messrs. Hall Motor Fuel Co., Ltd., had in recent years carried out that process in a slightly different way, namely, by passing the vapour of the petroleum over heated bauxite, and they had been able to show a very important point, namely, that that most difficult refinable substance, cracked spirit, was capable of simple and easy refining without any chemical treatment at all, and with the very minimum of loss.

With regard to the next fraction, gas oil, little was needed to be said about it.

Heavy Oil and Paraffin

Dr. Dunstan then dealt with one of the most important fractions from the point of view of the refiner, namely, the heavy oil and paraffin. Certain oils had paraffin wax in them —not before they were distilled, but after. In view of the large demand there was for wax for a multiplicity of purposes, it was imperative to get the maximum yield out of the oil. It was a somewhat difficult refining operation to get the wax in the right condition in the heavy oil and paraffin distillate, so that it would filter readily and be easily refined. In brief, the process was as follows: The fraction containing the wax if badly coloured should be distilled. It was then cooled to, say, 45°F. by passing through an apparatus in which a freezing mixture was in counter current. Then the wax and oil was pumped through a filter press, 150 lbs. pressure to the square inch. The adhering oil was squeezed away and the wax was left in the press. The wax at that stage was of a yellow colour. It was then purified in a very ingenious way. It was in fine crystals, in the interlacing sections of which heavy oil was found. That oil had to be got rid of, and it was removed by a process called sweating. The oil was literally sweated out. It still possessed a colour, and that colour was generally removed by one of the absorption methods. The filtrate from the wax was the lubricating oil base. From that, by distillation, were obtained distillate lubricating oils like gas-engine oils, and a residue oil, which was a very high viscosity, which found a purpose in lubricating steam cylinders and motor crank cases. When the oil had been distilled down to the heavy oil and paraffin stage there was a residue in the stills. That might be a pitch or a coke residue. Coke formed from petroleum was extremely pure, almost pure carbon in fact, and found a ready sale to the manufacturers of electric light carbons and crucibles. If pitch was formed it could either be used as a works fuel or it was susceptible to oxidation and particularly sulphuration, forming artificial asphalt.

Fuel Oil

Dealing with one or two side issues in refining, first of all fuel oil, which was now so much in the public eye, was usually a topped oil. Fuel oil was being used in the Navy and in the Mercantile Marine, and railway companies were waking up to the possibilities of utilising pipe lines instead of the innumerable trucks which now littered their permanent way. Certain very wide specifications needed to be observed by the refiner. He must not have a flash-point so low that the Board of Trade would object, or a viscosity so high that the pipe lines could not handle the product, or so much water that the flame-burner went out, or so much grit and dirt that the gauzes were obstructed. But, bearing in mind these points, the refiner had not got very much else to do.

Another petroleum product—petroleum jelly—required a certain specialised care. That was found in quite a number of oils, which on distillation would yield wax. Petroleum jelly seemed to be an amorphous colloidal substance which, on being distilled or strongly heated, produced crystalline wax. For the manufacture of it one selected very carefully a crude oil which did not need too much refining. The oil was distilled in steam down to the right consistency and then a reddish brown colour was seen, which was removed by careful refining. That refining, again, was done by the physical-chemical method of absorption on to Fuller's earth or bauxite.

Toluol

An interesting point in connection with refining had arisen during the course of the late war. It would be within the knowledge of everyone that in the early days of the war there had been an extremely urgent demand for toluol and that the precious coal-tar hydrocarbon had fetched phenomenal prices. That substance occurred as such in certain petroleums, notably in petroleums from the Eastern Archipelago and from Persia. It could also be made from petroleum by a drastic method of cracking at high temperature. In the first case, the toluol occurring naturally in petroleum, it became merely a method of fractionation to isolate it, but the fractionation had to be very precise and in order to get a good yield of the toluol present in petroleum it required all the arts of the distiller. The Asiatic Company had produced innumerable tons of toluol from their Borneo crude oil. In fact, the orthodox system of getting toluol from coal tar mentioned in the text-books took a very back seat indeed compared with the toluol produced from petroleum. A curious thing about the toluol in natural petroleum was that it was by no means so rare of occurrence as had been previously supposed, and there were very few natural petroleums out of which toluol could not be got. It was much purer than coal tar toluol.

With regard to the cracking method, when petroleum was cracked one obtained a multiplicity of products, and, according to the temperature, so one got or did not get aromatic hydrocarbons. At about 700°C. to 750°C. most petroleums would break up and give a cracked product which contained toluol. Having got the toluol-containing spirit, it was merely a question for the refiner to extract from that toluol spirit the hydrocarbon in question. Toluol, T.N.T. and derivatives of toluol were readily and easily obtained from that complex mixture.

The imminent shortage of petrol had led to all sorts of demands being made to increase the supply. For example, the gas escaping from the petroleum wells, was now, in most districts, stripped of its gasolene contents. But the most profitable way of increasing supplies from petroleum sources appeared to be in the direction of cracking, by which was meant the dissociation, the breaking down, of complex molecules into smaller ones, the difficulty being to avoid going too far and breaking down the hydrocarbons into carbon and hydrogen. A middle course was necessary, whereby the complex substances could be selectively broken down. Modern cracking dated back to a famous patent in 1890 by the late Sir Boverton Redwood and Professor Dewar, who discovered that when petroleum was heated under pressure a simplification of structure took place.

Dr. Dunstan then showed a series of slides illustrating the different types of stills mentioned in the lecture.

On the motion of Dr. W. R. Ormandy, a hearty vote of thanks was accorded to Dr. Dunstan for his interesting and valuable lecture.

The Institute of Metals

Papers at the Annual Autumn Meeting at Barrow

THE autumn meeting of the Institute of Metals was held at Barrow this week, under the chairmanship of Engineer Vice-Admiral Sir George Goodwin, the president. At the opening meeting, on Wednesday, the Mayor of Barrow, Colonel W. F. A. Wadham, who is a director of the Barrow Hematite Steel Company, Limited, in welcoming the members, said the chief interest of the Institute was in connection with non-ferrous metals, while Barrow was specially interested in ferrous metals. The discovery of huge beds of iron ore in the Furness district, was the origin of the rise of the town. This discovery led to the construction of a railway to carry that ore to the coast, and later on the smelting of the ore was commenced, and other industries were put into operation.

Sir George Goodwin, in reply, said that while their chief interest was in non-ferrous metals, they were in close touch with ferrous metals, such as those worked in Barrow. The rapid growth of Barrow specially appealed to them, for it showed that progress was being made.

We give below summaries of a number of the papers read :—

Brass Foundry Practice at Vickers, Ltd.

MR. H. B. WEEKS, in a paper on "Brass Foundry Practice at Vickers, Ltd., Barrow-in-Furness," described the brass foundry and the progress that had been made there during the last 50 years. He dealt with loose pattern moulding, plate moulding, "dry" and "green sand" work, loam moulding, chill moulding and the dressing and fettling, including sand-blasting. Reference was also made to the premium bonus system which is in operation. One of the most predominant factors in the successful working of the foundry, Mr. Weeks stated, was probably the system adopted for metal control. He also referred to the means which were in operation in order to keep the various alloys to their proper composition. The foundry equipment was described, including electric and hydraulic cranes, drying stoves, melting plant, riddles and sand mixers, portable mould dryers, ladles, ash washing and the briquetting of scrap by hydraulic pressure. The metallurgical side, he stated, was under scientific control, and experimental work had been the means of developing a number of alloys that had found useful application throughout the services. The total output of castings from the brass foundry during the five years covering the war period was nearly 17,000 tons.

Crystal Growth in Metals

"Crystal Growth and Recrystallisation in Metals" was the subject of a paper by Professor H. C. H. Carpenter and Constance F. Elan. The research described was divided into two main parts. In the first the authors described their observations on the growth of crystals in an alloy of tin and antimony containing 1·5 per cent. of the latter metal. It was shown that in all the cases studied growths took place by "boundary migration" and not by coalescence: that large crystals could grow at the expense of small ones, and vice versa; that orientation did not influence growth, and that a crystal could grow and be grown into at the same time.

In the second part of the paper, so far as could be judged from the experiments made to test the question, it was found that the crystals of castings did not grow provided care was taken to prevent deformation. The authors' results indicated that work followed by heat was the real cause of crystal growth. The conditions under which very large crystals were formed had been carefully studied and defined. The crystallisation was always observed to take place in the boundaries of the old crystals. No existing theory of crystal growth explained the new facts described in the paper. These theories were discussed by the authors.

Influences of Gases on High-Grade Brass

When melting brass in ordinary fuel furnaces the metal comes into contact with divers gases, and their effect on the metal and the quality of the castings was the subject of this paper by Messrs. T. G. Bamford and W. E. Ballard. The tendency of gases towards absorption was determined by gradually heating a small sample of brass in a comparatively large volume of each gas and noting pressure changes. The rate of chemical reaction was measured by maintaining constant gaseous pressure above a sample for a considerable time at selected temperatures and measuring directly the volume of gas absorbed. An entirely new apparatus was designed with which to study the solubility of gases in brass. The novel feature was that determinations were made at atmospheric pressure. External variations of pressure during any experiment were guarded against by means of a compensating bulb.

Large scale casting experiments were carried out to determine under what thermal conditions of casting the porosity due to gases could be eliminated.

Briefly summarised the results of the experiments had established the following facts: Sulphur dioxide reacts with high grade brass at all temperatures between 700°C. and 1,100°C. at atmospheric pressure. The rate of reaction is rapid between 800°C. and 1,100°C., but above this temperature there appears to be a reversal. Hydrogen is soluble in 70 : 30 brass in large quantities, the quantity absorbed increases steadily with rise in temperature, and large quantities of the gas may be removed by heating the solid metal in such gases as carbon dioxide or air. Hydrogen dissolves in zinc in small quantities, and the solubility decreases with the rise of temperatures.

Provided the pouring temperature was maintained as high as 200°C. above the liquidus porosity due to gases was absent. A higher temperature was needed for tube casting than for solid billets of similar weight. Incidentally it was shown that where unsoundness existed it was more generally confined to the top of the casting, and further, as a comparative test, it was immaterial in which part of a tube or billet a test piece was taken provided a uniform system was adopted throughout.

Alloys of Aluminium and Magnesium

A paper on "The Constitution of the Alloys of Aluminium and Magnesium," by Mr. D. Hanson and Miss Marie L. V. Gayler, described the results of an investigation into the aluminium magnesium series of alloys. The equilibrium diagram given by Grube, which previously had been the only one available, was incomplete. The work of the authors showed that it needed considerable revision, and they had worked out the complete constitution over the whole system of alloys.

It was shown that aluminium and magnesium formed two compounds with each other. One had the formula Al_3Mg_2 (37 per cent. magnesium). It had a melting point of 450°C., at which temperature there was a maximum on the liquidus curve. It formed an eutectic with aluminium, containing 33 per cent. magnesium, the freezing point of which was 447°C. Aluminium could dissolve Al_3Mg_2 to give a solid solution containing up to 11 per cent. magnesium at 420°C. and 9 per cent. at 150°C.

The second compound probably had the composition Al_2Mg_3 (57 per cent. Mg). It formed eutectics with both Al_3Mg_2 and magnesium. The $Al_3Mg_2-Al_2Mg_3$ eutectic contained about 41 per cent. magnesium and melted at 446°C. Al_2Mg_3 would dissolve Al_3Mg_2 and Mg in appreciable quantities, and alloys containing from 47 to 60 per cent. magnesium consisted of homogeneous solid solutions. The eutectic of Al_2Mg_3 and magnesium contained about 70 per cent. magnesium and melted at 436°C. Al_2Mg_3 was soluble in magnesium. The saturated solution at 420°C. contained about 10 per cent. aluminium, and at 150°C. about 9 per cent. aluminium.

The solubility relationships of all the constituents in the solid alloys had been determined by annealing samples of the alloys for long periods followed by quenching and examining them under the microscope. The solidus had also been determined in the same manner.

Admiralty Gun-Metal

"The Effect of Increasing Proportions of Antimony and of Arsenic respectively upon the Properties of Admiralty Gun-metal" was the subject of a paper by Mr. R. T. Rolfe. In this research two series of synthetic alloys were prepared showing, in one series, a progressive increase in antimony up to 1·5 per cent., and in the other series, in arsenic up to 1 per cent., both sand and chill castings being made, while casting temperatures were determined and complete analyses made of all the different compositions. Each alloy was later re-melted, and a second series of sand and chill castings obtained, of which again analyses were made, casting temperatures determined and mechanical tests carried out.

The following were the conclusions arrived at :—

Antimony.—In sand-cast gunmetal, this impurity progressively increases the hardness and decreases the strength and ductility. If a proportion of about 0·75 per cent. is exceeded, the minimum specification figures for tensile strength and elongation may not be reached. Chill castings show the same tendency in a modified degree. Antimony has no effect on the soundness of the castings except in the case of chill-cast metal melted twice, when with increasing antimony is associated increasing unsoundness. To avoid this a figure of 0·75 per cent. must not be exceeded. No effect on the microstructures can be observed.

Arsenic.—In sand-cast metal melted once, increasing arsenic causes a falling-off in both strength and ductility. A maximum figure of 0·3 per cent. is suggested. In remelted metal and in chill castings this effect of arsenic is rather masked.

Arsenic has no effect on soundness except in the case of chill-cast metal melted twice, when increasing arsenic is associated with increasing unsoundness. A maximum figure of 0·4 per cent. is suggested. Arsenic has no influence on the hardness. The arsenic figure influences the microstructures in sand castings, but not in chill castings.

Beta Brass

Mr. F. Johnson, in a paper on "Some Features in the Behaviour of Beta Brass when Cold-Rolled," gave a description of the mechanical properties of a brass containing 55·6 per cent. copper (made from electrolytic copper and electrolytic zinc) before and after cold-rolling. The alloy consisted entirely of crystals of the beta phase, no free alpha being observable, although if cooled under equilibrium conditions some alpha should accompany the beta. A reduction of 50 per cent. in rolling (cold) resulted in the raising of the tensile strength from 22·6 to 38·2 tons per square inch, the percentage elongation falling from 27 to 8½ per cent.

An interesting feature of the microstructure of the cold-rolled alloy was the occurrence of a maze of dark lines, which persisted after repolishing and re-etching. These lines represent planes of displacement and they "fault" one another, as was shown in the photo-micrographs. They were of a higher degree of magnitude than slip bands or "etch bands," which were the etching-record of slip bands. The author suggested that they belonged to the same category as the Neumann bands, named after the investigator who discovered them in meteorites, and the existence of which had been proved in terrestrial iron (ferrite) subjected to shock. On a cleavage face these bands were parallel either to the diagonals of a square or to the lines which joined the angles of a square to the centre of the opposed edges. These corresponded to the faces of the trapezohedron.

The author gave some indications of the crystallographic features of the cube, octahedron, rhombohedron and trapezohedron, and the measurement of some of the angles formed on a random face by the deformation bands produced in the sample of cold-rolled beta brass. Low-temperature annealing resulted in the crystallisation of the alpha phase along the crystallographic planes of displacement, but high-temperature annealing (in the stability region of the beta phase) resulted in the disappearance both of the deformation bands and of the post-deformation alpha. No refinement of grain resulted from the low temperatures annealing, which, however, caused an almost complete restoration of the mechanical properties originally associated with the unrolled alloy. The deposition of alpha along the planes of displacement caused by low-temperature annealing recalled the explanation offered by Osmond and Cartland of the amelioration of mild steels by quenching and tempering.

Reference also was made to a curious stratification, visible to the naked eye, which cold-rolling developed in the alloy and which was revealed on a sawn face.

A Failure of Manganese Bronze

Mr. J. H. S. Dickenson, in a "Note on a Failure of Manganese Bronze," said that examination of a manganese bronze end-plate from a turbo-alternator rotor which failed in service, showed that certain fractured peripheral projections had been rendered brittle by the contact of fluid solder which had penetrated along the junctions of the crystalline grains.

The end plate was shown by analysis and microexamination to be a typical beta brass of simple polyhedral structure. Bend tests taken from the inner, unaffected portions showed toughness and ductility, whether tested at the room temperature or as high as 200°C., but collapsed instantly under small loads, with an intergranular fracture, and no appreciable distortion if heated sufficiently to melt the point of a stick of soft solder applied to the side in tension. No such effect was obtained when solder was melted on the side in compression, or when a test piece was soldered on the tension side and stressed with the solder in the solid state. It was found that there had been local heating in the rotor and the solder appeared to have penetrated while the beta brass end plate was running under stress.

An investigation followed to elucidate the conditions under which alloys of the manganese bronze type, *i.e.*, beta brasses, as well as alpha and mixed brasses, were prejudicially affected by contact with fluid solders, the special points on which information was required being to ascertain the stress required to produce failure, and also to what extent variation in composition and microstructure affected the result.

The effect of bringing fusible alloys (melting at 69·5°C. and 93°C.), soft tin-lead solder, and tin into fluid contact with heated and stressed test bars of various kinds of brass had been ascertained. In all cases the result was greatly to reduce the maximum stress and cause intergranular fracture this being by far the most marked in the case of beta brasses of simple polyhedral structure, less so when alpha and beta constituents occurred together, and nothing like the same extent in alpha brass with interlocking crystalline grains. These differences formed a further example to show the danger of permitting metallic crystals to develop smooth and regular outlines. It was suggested that further work in this direction might throw additional light on the phenomenon of season cracking.

The Allotropy of Zinc

This paper, by Miss Kathleen E. Bingham, reviewed briefly some of the previous work on the allotropy of zinc, and gave an account of the author's own research.

While some of the observations in this research gave negative results (*e.g.*, thermal E.M.F. measurements and thermal curves), yet on considering the larger part of the evidence it was difficult to avoid the conclusion that zinc existed in three allotropic forms.

The breaks in the resistance temperature curves were so slight as to suggest that the electrical resistance of zinc was hardly affected by the allotropic chances. Observations on quenched material of some of the properties indicated approximately the temperatures of the critical changes as follows :—

	Deg. C.		Deg. C.
Electrolytic potential...............	180(?)	...	330 to 340
Specific gravity	170	...	—
Hardness	160	...	330
Mechanical Properties—			
Maximum stress	180	...	310
Elongation	180	...	310

Tensile tests at high temperatures gave strong confirmation of the critical changes at 190°C. and 300°C. (maximum stress) and 160°C. to 180°C. (elongation). The microstructure showed one system of crystal boundaries in the α range of temperature, two interpenetrating systems in the β range and three in the γ range. It had been shown also that recrystallisation took place on heating the cast material and cooling it slowly from below the melting point to the ordinary temperature, a further indication that some allotropic change occurred.

Tin-Antimony-Copper Alloys

A paper on "The Constitution and Structure of Certain Tin-Antimony-Copper Alloys" was submitted by Messrs. O. F. Hudson and J. H. Daritz. The work of the authors had for its immediate object a study of bearing metals of a particular composition (tin 89 per cent., antimony 8·7 per cent. and copper 2·3 per cent.), principally with a view to ascertaining if any rules could be formulated connecting easily recognised variations in structure with definite casting conditions. Before proceeding to a detailed examination—photomicrographic and otherwise—of the complicated tin-antimony-copper bearing metals, the authors dealt with the two binary systems, tin-copper and tin-antimony, since the ternary allows were most conveniently considered as a simple combination of alloys of the binary systems of corresponding composition. In other words, the constituents of the binary alloys appeared practically unchanged in composition and properties in the ternary alloys, the characteristic structure in the white metals being due rather to the special arrangement of these constituents than to the appearance of any new phase.

The authors considered that the essential condition for the production of a coarse angular type of structure in bearing alloys was undisturbed cooling from a particular temperature, and that the casting temperature of a white metal bearing should not exceed this critical temperature. Near the critical temperature the structure appeared sensitive to differences in the rate of cooling (temperature of mould and size of casting), but above or below this temperature the type of structure was unaffected by comparatively wide variations in the rate of cooling. The critical temperature would depend on the composition of the alloy, and in the case of the alloy used in these experiments it lay between 300°C. and 350°C. In other alloys in which solidification began at higher or lower temperatures the critical temperature would be correspondingly higher or lower, but generally the angular type of structure would result when the casting temperature was about 50°C. above the temperature at which the alloy began to solidify.

German Chemical Industries

THE Peace Treaty required that Germany should deliver to France, during each of three successive years, 30,000 tons of sulphate of ammonia, 35,000 tons of benzol, and 50,000 tons of coal tar. The Reparation Commission reserved the right to one-half the supply of dyestuffs and chemico-pharmaceutical products on hand at the time of the signing of the treaty; also an amount up to one-fourth of the product up to January 1, 1915. It would naturally be inferred that having to supply such large quantities to other nations the industry would have suffered, but from the following summaries published in the *Board of Trade Journal* for September 9, it will be seen that a year after these provisions became effective the German chemical companies are able to pay greatly increased dividends.

Chemical Trade and Coal Supply

Resumption of trade in chemicals is dependent upon the supply of coal. Shortage in coal has brought a large part of the industry to a standstill, or, at least, has caused great shortage in production. If now a shortage of raw material is to follow, such deficiency in the supply of sulphuric acid, caustic soda, pyrites, tar, sugar, and casein will itself be traceable to the scarcity of coal. The *Rhenisch-Westfalia Zeitung* says some relief was obtained at the end of February by the delivery of American coal, which had been ordered, but was not until then available.

The chemical industry seems to be at a standstill. The chemico-pharmaceutical industry is in some respects in a better situation than in January, in other respects in a worse position. Dyestuffs have shown a brief revival because of the receipt of a moderate amount of coal.

The shellac industry also makes an encouraging report. Soap reports run from "bad" to "fair." Asphalt and tar products suffered from lack of raw material. Coking plants, producing tar, ammonium sulphate, and benzol report a freight scarcity; business was in other respects improved over a year ago. Ethereal oils were sluggish, but improving. Benzine and turpentine were not coming on the market. Weak conditions prevailed in the sulphuric acid and fertiliser industries; in the case of the latter, shortage of materials made it impossible to satisfy the demand.

The chemical industry suffered heavily during the past year by reason of the shortage of coal, which became extraordinarily acute towards the end of the year, causing many industries to close. The shortage in other raw materials became more and more serious at the same time that the world demand for chemical products became so insistent. At this juncture many foreign countries put an embargo on the importation of German products. Finally, the 25 and 50 per cent. deliveries required in the peace treaty affected the chemical market seriously.

Report of Berlin Chamber of Commerce

The report of Berlin Chamber of Commerce for 1920 states that the chemical industry and the trade in chemicals, raw materials, and auxiliary products suffered in war time greater changes than most branches of industry. Germany was in normal times heavily dependent upon foreign countries in many matters of production and distribution; this field was entirely cut off by the war. A transformation of the whole industry was the only solution. The brilliant achievements of those who had the matter in hand are testified to in the manufacture of explosives and artificial nitrates. And yet these acheivements are merely isolated instances among the many which were accomplished with the raw materials drawn from domestic and a few neutral sources.

Increase in salaries and in wages of operatives, as well as ever-rising costs of coal and raw material resulted, of course, in continuous increases in costs, which were accentuated by the shortage in coal and transportation. The effect was felt all along the line; the selling price was a mere barometer of conditions. No relief may be expected until the rate of exchange and inflated values have been brought back to normal. The demand is good, indeed, almost impossible to meet, and yet production cannot possibly be accelerated.

Government Control

Government control of sulphuric acid and other basic products grew more rigid rather than more lax. The shortage of pyrites made it useless to attempt to meet the demand. The maximum prices were set higher and higher, but production was dependent upon more fundamental things than money.

Hydrochloric acid was released from control in March, 1919. After a few months' production conditions were such that sales could be made even in Scandinavia and Finland, so that business in this line may be said to have been good. There was also a heavy demand for Glauber's salts, a by-product of hydrochloric; it was impossible to fill the demand in Scandinavia.

Liquid anhydrous ammonia was in great demand. The small production of ammonium carbonate never permitted market prices to be within reason. Raw material for ammonium sulphate was exceedingly scarce, and yet the maximum price was so low that manufacture was unprofitable. Nitrogen prices reached a business-profit level only toward the end of the year. The production of spirits of ammonia was obstructed at intervals, but it became profitable in time.

Potassium prices were raised again and again, but the demand was still so keen that production was worth while. Copper vitriol was in heavy demand, but speculation drove the prices to too high a point. There was also a strong market for citric acid, but the raw material could not be obtained in Italy. Sulphuric acid was needed for cooling, for treatment of skin diseases, and for preservation of fruit. Wolfram, molybdenum and vanadium could be obtained only in very small quantities.

Paints and Dyes

The marketing of pigments and dyes was restricted in the early part of the year because of the revolution; later on conditions improved until it was even possible to export some to neutral countries.

The Berlin Chamber Report adds: "With the signing of peace, export to France, Belgium and Italy set in until pre-war figures were met, especially in Belgium and Italy. It is very agreeable to note that the French trade also promises to pick up. England is still holding off. America, once a favourite territory, is still closed to us, and it is doubtful whether after peace is ratified our export to that country

can be built up again, since the dye industry is making such strides over there. Inquiries as to the market in the Orient indicate that that trade is reviving. In general, it may be said that German pigments and dyes will hold their markets abroad."

The supply of coal, soda, sulphuric acid, and chrome salts was so low last year that it was impossible to fill the orders that piled in at the end of the year. "Then the eight-hour day has become a vital obstacle, as it is impossible to put some of the manufactures on such a basis. Double shifts are no solution; overtime is prevented by the attitude of the workers' organisations, even though individuals are in favour of it. Except for these circumstances, we might be able to build up foreign credits as a means of procuring food."

Pigment and Dye Industries Combine

The pigment and dye industries have found it necessary to combine—the German *Bunt- und Mineralfarben Industrie* and the Union of German Dye Industries being formed. These organisations have justified their existence in arranging for allocation of raw materials and the establishing of fixed prices, putting an end to profiteering. Goods for foreign sale were put at a higher price, so as to equalise the low rate of exchange. Prices are now about the same for all consumers. Altogether, the dye industries are in a favourable situation, except for the shortage of coal and raw materials.

The lac and varnish industry had a heavier demand than in 1918, but could not meet this demand, as the eight-hour day and scarcity of material prevailed almost throughout the year. In December the restrictions on copal, shellac, rosin, and turpentine oil were removed; linseed oil is still under control.

Production is still behind the average of former years. Increased production could hardly be hoped for, in the face of the restrictions on the importation of benzine. The industry suffered by reason of the allocation of the raw materials to organisations outside of the trade.

Reports of Chemical Companies

The *Chemische Fabrik Griesheim Elektron*, of Frankfort, declared in 1919 a dividend of 12 per cent., as contrasted with 7 per cent. in 1918—and this after setting aside over 4,000,000 marks for depreciation. This company explains the profits as arising from increased value of pre-war stocks. The *Chemische Fabriken*, of Urdingen, explain similar profits through the sale of stock held abroad. The *Aktien Gesellschaft fur Anilin fabrikation* ("Agfar"), of Berlin, reports gross profits of 24,877,000 marks in 1919, as compared with 13,700,000 marks in 1918, warranting a dividend of 18 per cent. The *Badische Anilin und Soda fabrik* closed its works at Ludwigshafen and Oppau in November because of shortage of coal; the nitrogen works at Mersburg shut down because of political disturbances. In all these cases only a fraction of full production was reached by June, 1919, and yet the firms report large profits by reason of the great rise in prices of dyestuffs. Over 60,000,000 marks were written off and yet the firm declared net profits of nearly 30,000,000 marks, justifying a dividend of 18 per cent.

The *Farbwerke*, of Höchst-am-Main, report that manufacturing was largely at a standstill during 1919 and early in 1920, only the pharmaceutical departments producing normally. But here, too, export sales enabled the company to declare a 14 per cent. dividend, as contrasted with 12 per cent. in 1918, on a basis of net profits of nearly 25,000,000 marks, even after deduction of an extra expense of 80,000,000 marks in increased wages. The gross profits of the *Chemische Fabrik Rhenania*, of Aix-la-Chapelle, advanced from 1,938,000 marks in 1918 to 5,723,000 marks last year. The dividend was increased from 10 to 25 per cent. *Kalle & Co.*, of Biebrich, reported that only a part of the more important departments were operating, and yet, after deductions for depreciation, the dividend was increased from 7 to 14 per cent. The report is pessimistic as to prospects from 1920.

The Department of Overseas Trade have received inquiries from a firm of manufacturers' agents in Ottawa who wish to obtain the representation of United Kingdom manufacturers of glassware and druggists' sundries, on a commission, sales or consignment basis for the United States, British West Indies, and the whole of Canada.

Italian Chemical Industry

Mr. Charles L. Parsons' Impressions

MR. CHARLES L. PARSONS, in a letter to the September issue of the *Journal of Industrial and Engineering Chemistry*, gives the impressions he gained of the Italian chemical industry while attending the International Chemical Conference in Rome last June. In our issue of August 7 we gave the official account of the proceedings as supplied to the Society of Chemical Industry, but Mr. Parsons now supplements this by a general impression of the Italian chemical industries gained during his visits to numerous works.

"Following and during the meeting, we were taken to see something of Italy's chemical development. We were received with charming and open-handed hospitality, but best of all we were actually shown the plants and their details, not simply walked through them as is so often the case in America. The Italian was justly proud of the work of his chemists and engineers, and was anxious that his guests should see something of their actual accomplishments. There was no secrecy so far as we were concerned; they described their methods and their apparatus, and seemed to invite inquiries where anything was obscure. If I can judge from the treatment I received, one would believe that Italy's industries had reached that stage where full co-operation was deemed to be the policy best for all.

"Naturally, Italy's plants, like many of our own, are being changed, for the main part, from the production of war material to uses consistent with peace. The plant at Segni, known as the Bombrini Parodi-Delfino, which was manufacturing balastite so successfully when I visited it first in 1916, is manufacturing sulphuric and nitric acids for the general chemical markets, and the nitroglycerin is now largely used for the manufacture of dynamite for commercial explosive. The plant owes its success chiefly to the enrgy and ability of the brothers Leopoldo and Sebastino Parodi-Delfino.

"The 'Electrochimica Pomilio,' located in Naples, is a comparatively new venture of Ing. Prof. Umberto Pomilio, who was a genial and delightful host who could, and did, address his guests fluently in three languages, as well as entertain them royally. His plant is successfully turning out caustic soda, bleaching powder, liquid chlorine, hypochlorites, and other products arising directly and indirectly from the electrolysis of salt. The plant is noteworthy and almost unique in the fact that it does not use a pound of coal or other fuel, depending entirely on electricity for both its power and evaporation. The evaporation is done by compressing the steam of evaporation mechanically and using it over and over again, supplying the small necessary heat addition by a small Reavell boiler, run by electricity, which gives 800 kilos of steam per hour. From 1 kilowatt-hour they get in practice 7 kilos of steam. The day spent at this plant and as the guests of Professor Pomilio at Pompeii will always be remembered by those present.

"A few days later we were all entertained by Ing. Ferdinando Quartieri, chief owner and manager of the largest chemical works in Italy, with branches at Cengio, Ferrania, Vado Ligure, Linate, Turin, and at Rho near Milan. These works for the main part were used for the manufacture of explosives and belong to the "Società Italiana Prodotti Esplodenti." They are now rapidly being converted to peace uses and are actively producing on a large scale. It was my privilege to visit the plants at Cengio, Ferrania and Rho. Lack of time, only, prevented me from seeing the others. At Cengio, at Ferrania, and at Rho many new and attractive buildings were being erected to meet the increased demand and to utilize the output of the old war plants. Coal from America and from England was being distilled, the coke and gas used or sold, and the by-products all recovered and used in the dye industry. Contact sulphuric acid plants and unusually well-designed nitric acid plants were still being utilized. Benzene, toluene, naphthalene, and their derivatives were being turned out in quantity. The saccharin plant was running full blast, and not simply aniline but many intermediates for the dye plant at Rho were being produced. Again at Ferrania, some 15 miles away, a smokeless powder plant was now being converted to produce celluloid, photographic films, artificial leather, bakelite (here called sepilite), &c., and was even now actually turning out in quantity most of these products."

British Association Meeting

To the Editor of THE CHEMICAL AGE.

SIR,—Referring to the leader in your issue of the 4th instant, on the above subject, I quite agree that the meeting of the Chemical Section left something to be desired, but there are several simple explanations for that state of affairs.

The reason for the small attendance on the second day, and for the shortness of the discussions, I venture to suggest, was primarily that the meetings of two allied sections were combined for the same morning at practically the same hours. This divided the interest of members anxious to hear all the papers, detaining a considerable audience for two papers, who would otherwise have been present at the Chemical Section papers, which were read at about the same time.

We also agree that the paper of Wells and Southcombe had little strikingly new for those who had seen or read our two previous papers. The case had been very different if industrial conditions had been normal since the war.

The results of several important applications of the "Germ Process" to oils in use on a large practical scale on different types of engines and machinery, and on railways, would have been recorded at the meeting but for the abnormal delays incidental to the present state of industry. Some of these trials, started in the laboratory over 18 months ago, in normal times would have passed into adoption in everyday use within a year or less. Tests in one's own laboratory can be expedited. For results of trials on a practical scale one must wait the convenience of many others who have much else besides oil testing to carry out or supervise.

But for these unavoidable and interminable delays, there would have been ample valuable new material to place before the British Association and the world.—I am, &c.,

HENRY M. WELLS.

11, Haymarket, S.W.1.
September 9.

Union or Disunion

To the Editor of THE CHEMICAL AGE

SIR,—With reference to the article which appeared in your issue of the 7th August entitled "Union or Disunion," I should like to point out one very important fact, namely, that when your contributor states that ". . . . a Professional Defence Association, . . . would accept the only recognised professional hall mark—membership of the Institute of Chemistry, it being granted that no professional chemist under the Institute regulations need be without this seal," he is, quite unintentionally, I am sure, excluding a large number of chemists who are qualified in the only true way to practise their profession, namely, that they are so qualified by the knowledge they possess.

I am sure you will agree that the possession of adequate knowledge is a totally different thing from the ability to satisfy a number of conditions and obligations as to how that knowledge was obtained. If I may be permitted to say so the possession of knowledge is immeasurably more important than a statement giving proof as to how that knowledge was acquired, and this fact is the one I wish to emphasise.

The Institute of Chemistry should, in my humble opinion, open its doors still wider, and waiving all conditions as to training, grant its diplomas to any who can satisfy its examiners—in other words, abolish all conditions as to training, and let the examination decide the fitness, or otherwise, of the candidate for its approval; for, as I understand the regulations, conditions of training are prescribed only to exclude the mere book-man who may be deficient in practical training.

This state of affairs would be quite all right were the Institute's examinations only theoretical, but they are not, since they include a practicel examination and a severe one at that; therefore, is it to be conceived that anybody could, from book-knowledge, pass a practical examination, such as is conducted by the Institute of Chemistry, and which, I think, may even extend over two weeks? Personally, I think it almost, if not quite, impossible.

There are many chemists in industry who could pass the Institute of Chemistry's examinations, but who could not satisfy the Institute's conditions as to training, and to meet the case of these men, so far as I am any judge at all, two things only should be required of intending candidates by the Institute, namely, a letter of introduction giving proof of moral character, and the power to satisfy its examiners at its examinations.—Yours &c.,

FREIHEIT.

The Institute of Chemistry

Further Action Regarding Chemists' Salaries

SEVERAL points of interest are recorded in the new number of the *Proceedings* of the Institute of Chemistry. The publication of the statistics compiled from particulars sent in by members in whole-time appointments with regard to their salaries and conditions attached thereto is believed to have had beneficial effects in several ways. Members who were in receipt of remuneration inferior to the average in many cases took steps to improve their positions. The Council pointed out to Government Departments and other employers of chemists that it was imperative to revise the conditions attached to appointments which became vacant. The figures have also served as a useful guide to chemists taking up their first appointments, and have assisted the Registrar in advising firms who were engaging the services of chemists for the first time. The Council believe that the general position has improved considerably since these statistics were compiled, and have since decided to send out a further circular letter in order to ascertain whether the average remuneration of chemists is changing proportionately to the increased cost of living.

The Council have decided that candidates who obtain the Associateship of the Royal Technical College, Glasgow, in metallurgy, after a four years' course, including chemistry, physics and mathematics, shall be regarded under the regulations of the Institute as on the same basis as those who obtain the Diploma in Chemistry, and shall be entitled to apply for admission to the Associateship of the Institute, provided they take additional courses in organic and physical chemistry, agreed upon between the Council of the Institute and the professors of the college, and pass the class examinations in all the required subjects. The Chemistry Board of the College has decided that candidates for the diploma of A.R.T.C. in chemistry and in metallurgy shall be required to pass an examination in French and German translation without the aid of dictionaries.

The Council express regret at the decision of the authorities of the City and Guilds of London Institute to close the Finsbury Technical College. The authorities have undertaken to try to make arrangements for those students who have not finished their courses by July, 1921, to complete them elsewhere. A number of registered students of the Institute who are preparing for the Associateship are affected. The Council of the Institute are anxious to afford these students, in their somewhat uncertain position, every possible assistance, and in the present emergency have offered the use of the rooms of the Institute for any meeting of past and present students of the College.

The Publications Committee have been obliged, for various reasons, to abandon the proposal to publish a formal volume recording the services rendered by chemists during the war. A number of chemists had kindly offered to co-operate in the work, but the subject is so extensive and the problem of collating and co-ordinating the various divisions of it so involved, that the authorship could hardly be undertaken except by a chemist not only well acquainted with all the activities of chemists throughout the war period, but also able to devote the necessary time exclusively to it.

With regard to research chemicals, the Council have received from the Association of British Chemical Manufacturers a more complete list of the research chemicals which can be supplied by members of the Association than was previously furnished. The list contains the names of 505 substances, with an indication of the firms who are in a position to supply them, and in addition a supplementary list of 30 substances which members of the Association are prepared to make if there is sufficient demand. The Association points out that the next few years will be critical ones for the fine chemical industry, and unless sympathetic treatment is received from the Government, and cordial support from research chemists, the industry will inevitably fall back into its pre-war state of comparative insignificance.

Midland Glass Trade

Shortage of Boy Labour

At a largely attended meeting of the members of the National Society of Flint Glass Workers at Dudley on Saturday, Sept. 11, the hope was expressed that the proposed legislation affecting boy labour at night would be withdrawn. If effect were given to it Mr. W. Bradford, the general secretary, stated that the glass industry would be paralysed. The cost of production would so increase as seriously to jeopardise the existence of the trade in this country. It was suggested that the employment of women should be in two shifts from 6 a.m. to 2 p.m., and from 2 p.m. to 10 p.m.

Another subject discussed was the shortage of carbonate of potash from Germany. Without it the brilliancy of the glass was affected, and the matter was the more serious because France, Belgium, and America had secured supplies for the present and future. Sir Arthur Boscawen, M.P., who had been written to, stated that enquiries made by the Board of Trade showed that the quantities of potash at present available, and likely to be available, from Germany were very small, and had already been sold for months ahead.

The Midland glass trade, it was stated, was exceptionally busy; the overseas demand for high-grade hand-made glass was heavy. America, from whom we were buying glass-making machines for the mass production of cheap glass, was sending here for table glass and ornamental glass. Jacobean and Georgian styles were in demand. The Glass Research Association would get to work this winter, the members of which, numbering about 140, include the leading glass makers in the country. Manufacturers were conscious of the need for bringing their work's practice into line with the advanced methods found operative in other countries, and the need for deeper and more extensive knowledge regarding the scientific facts underlying the various processes of manufacture was appreciated as never before. Research work in connection with optical glass was being undertaken by the British Scientific Instrument Research Association, established two years ago. The Glass Research Association would cover the problems of all other sections of the Glass Industry. A bureau of information would be established, and to this any member might apply for assistance in technical matters, and for other information, including developments with regard to glass machinery throughout the world. Mr. R. L. Frink, formerly of the Frink Laboratories, Lancaster, Ohio, U.S.A., was the Director of Research, and there were seven committees as follows: (1) Chemical and Physical Properties of Glass (at all Temperatures) (Chairman: Dr. W. Rosenhain); (2) Fuels, Refractories, Furnaces (Chairman: Mr. S. N. Jenkinson); (3) Glass Making Materials, Glass Founding — temperature measurement, annealing and finishing, other than decorative and marking operations (Chairman: Mr. C. C. Paterson); (4) Glassware Forming Operations — hand and mechanical — Glass Making Machinery (Chairman: Mr. J. Forster); (5) Lampworking (Chairman: Mr. F. Cossor); (6) Design, Lay-out and Equipment of Glass Factories (Chairman: Mr. R. S. Biram); and (7) Glass Decorative and Marking Operations (Chairman: Mr. E. J. Purser). The research work will in the first instance be carried out at Institutions such as the National Physical Laboratory, Sheffield University, and other Colleges and Technical Schools. Mr. G. E. Alexander is chairman of the Association; Messrs. Douglas H. Baird and Stanley N. Jenkinson, vice-chairmen; and Mr. E. Quine, B.Sc., secretary. The following gentlemen have been added to the Council: Board of Trade, Messrs. J. F. Ronca and S. W. Morrison; National Physical Laboratory, Sir J. E. Petavel; Refractories Research Association, Sir W. J. Jones; and Imperial College of Science and Technology, Professor J. F. Thorpe.

New German Chemical Combine

A Reuter's message from Berlin states that a new big combination is being planned in the German Chemicals Industry. A syndicate of capitalists is buying up stock in the Concordia Chemical Works and Vereinogen Chemical Works, both in Leopoldshall, and in the Stradtfurt and Duckau Chemical Works. Some of these concerns own important brown coal mines; others have potash interest. The aim is to create another big fusion similar to the aniline concern, which lately raised its capital to over 1,200,000,000 marks.

United States Potash Production

The returns so far received from the producers by the United States Geological Survey show that 110,309 short tons of crude potash salts, containing 30,899 short tons of available potash (K_2O), valued at $7,889,440, was produced in the United States by 73 firms in 1919. In 1918 there were 128 concerns operating plants, which produced 207,686 short tons of crude material containing 54,803 short tons of available potash (K_2O). In 1917 only 95 firms were operating plants, which produced 126,961 tons of crude material containing 32,573 short tons of potash (K_2O). More than 60,000 tons of domestic crude potash material was in storage in January, 1919, and most of the plants were closed for a part of the year, some of them for the larger part. These conditions were brought about by the expectation of large imports of potash salts from abroad—an expectation that was not realised. Instead, the sorted material was sold, and many of the plants were reopened in the autumn, though some of them were again obliged to stop work because of shortage of coal. The potash produced in the United States during the first three months of 1920, as reported to the Geological Survey from 43 plants, amounted to 42,008 short tons of crude material containing 11,969 short tons of available potash (K_2O), valued at $2,738,195.

The only notable gain is an increase in production from natural brines elsewhere than in western Nebraska. In 1919 six plants that produced potash from these brines made an output of 11,293 short tons of potash (K_2O). In the first quarter of 1920 five plants working the same brines produced 4,104 short tons of potash (K_2O), and if they continued production at the same rate during the entire year they would produce 16,416 short tons. The production of potash from cement kilns is proceeding at almost exactly the same rate in 1920 as in 1919, although there were only seven producers in the first part of 1920, against 13 in 1919. Alunite was used in 1920 only in experiments made by companies that reported production of potash from this material in 1919.

The following tables show the production of potash in 1919 and in the first three months of 1920:—

Potash Produced in the United States in 1919, Classified According to Source.

Source.	Production of crude salts (short tons)	Available potash (K_2O) (short tons)	Total value.
Natural brines:—			
Nebraska lakes ...	35,837	9,045	$1,889,416
Other brines ...	32,385	11,293	2,875908
Total ...	68,222	20,338	$4,765,324
Alunite ...	6,594	2,293	683,055
Dust, from cement mills	11,750	1,258	272,090
Dust from blast furnaces, silicate rock and kelp	2,200	250	62,035
Molasses distillery waste	8,498	2,792	801,331
Steffens waste water ...	12,459	3,616	1,078,291
Wood ashes ...	586	352	227,314
Total ...	110,309	30,899	7,889,440

Potash Produced in the United States in the First Three Months of 1920, Classified According to Source.

Source.	Production of crude salts (short tons)	Available potash (K_2O) (short tons)	Total value.
Natural brines:—			
Nebraska lakes ...	23,337	5,859	$1,280,819
Other brines ...	9,726	4,104	936,161
Total ...	33,063	9,963	$2,216,980
Alunite, blast furnace dust and silcate rock ...	1,336	565	174,912
Dust from cement plants	4,015	314	44,246
Wood ashes ...	108	65	36,671
Steffens waste water ...	1,870	440	118,666
Kelp and molasses distillery waste ...	1,616	662	146,720
Total ...	42,008	11,969	$2,738,195

From Week to Week

Dr. J. C. KERNOT has been appointed chief research chemist to British Glues and Chemicals, Ltd.

DRILLING OPERATIONS AT KELHAM, Notts., were started last week by Oilfields of England, Ltd. It is expected to touch oil in three or four months' time at 2,000 feet.

Dr. J. KENYON, of the British Dyestuffs Corporation research colony at Oxford University, has been appointed head of the chemical department at the Battersea Polytechnic.

Sir HERBERT JACKSON, President of the Institute of Chemistry, has been appointed a Governor of the Imperial Mineral Resources Bureau.

The annual meeting of the INSTITUTION OF MINING ENGINEERS opened at Manchester on Wednesday. The President, Colonel W. C. Blackett, was in the chair.

On and after October 1, the PATENT OFFICE LIBRARY, 25, Southampton Buildings, Chancery Lane, W.C., will be open to the public from 10 a.m. to 9 p.m., except on Christmas Eve and Easter Eve, when it will be closed at 4 p.m.

Professor F. J. WILSON has been transferred from the Chair of Inorganic Chemistry to that of Organic Chemistry, and Mr. W. M. Cumming, hitherto of the British Dyestuffs Corporation, Ltd., has been appointed Senior Lecturer in Organic Chemistry, at the Royal Technical College, Glasgow.

The New Zealand Minister of Customs states that apparatus for the manufacture of INDUSTRIAL ALCOHOL is being imported, and that in the near future thousands of gallons should be turned out annually. Should the process prove as successful as expected, the annual output will eventually run into hundreds of thousands of gallons.

JOHN LYSAGHT, LTD., now a part of Guest, Keen & Nettlefolds, have established rolling mills at Newcastle (N.S.W.), and, to provide the skilled labour necessary, 300 men from Newport (Mon.) will be transferred to Australia. Most of them are single, but 40 families will be taken to New South Wales. Their removal will only temporarily relieve the housing shortage, for at Newport six new mills at Lysaght's are nearing completion, and when these are ready the demand for housing accommodation will naturally exceed the present demands.

On Thursday, September 9, an outbreak of fire occurred at the works of E. WADE, WILTON & SONS, manufacturing chemists, Planet Works, Bramley, near Leeds. The fire broke out in a stone building where bitumen and naphtha were being boiled in a vat for the manufacture of paint. It is believed that the boiling over of the chemicals was the cause of the fire. Much damage was done to paint, and plant for the manufacture of paint, in the building; but the fire brigade prevented the flames from spreading to other buildings in close proximity and to other parts of the same works, in which quantities of inflammable material were stored.

Owing to the increase in railway rates which came into force on September 1, 1920, the BOARD OF AGRICULTURE FOR SCOTLAND have been obliged to sanction an increase of the agreed maximum prices for sulphate of ammonia previously announced for the period ending May 31, 1921. An increase of these maximum prices by 3s. 6d. per ton has been authorised in the case of all deliveries made on or after September 1, except when such deliveries are in fulfilment of existing unconditional contracts for delivery at the original prices. The original maximum prices will also remain in force for deliveries made ex works or by road.

Dr. STEPHEN MIALL, in his London letter in the *Journal of Industrial and Engineering Chemistry*, referring to the indigo situation, states: "The manufacture of synthetic indigo played havoc with the indigo planters in India and brought their profits down to a vanishing quantity. We understand that the Indian Government persuaded the indigo planters to combine together and have their problems investigated by trained chemists, who now report that by improved methods of cultivation, extraction and marketing, natural indigo of a quality superior to synthetic indigo can be produced at a lower cost. This natural indigo has been selling in Asia for some little while, and is now coming on to the English market. It will be interesting to find out if it can hold its own in Europe, but the present high price of coal and all its derivatives will afford a good chance."

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ANILINE. Some physical constants of pure aniline. C. L. Knowles. *J. Ind. & Eng. Chem.*, September, 881-883.

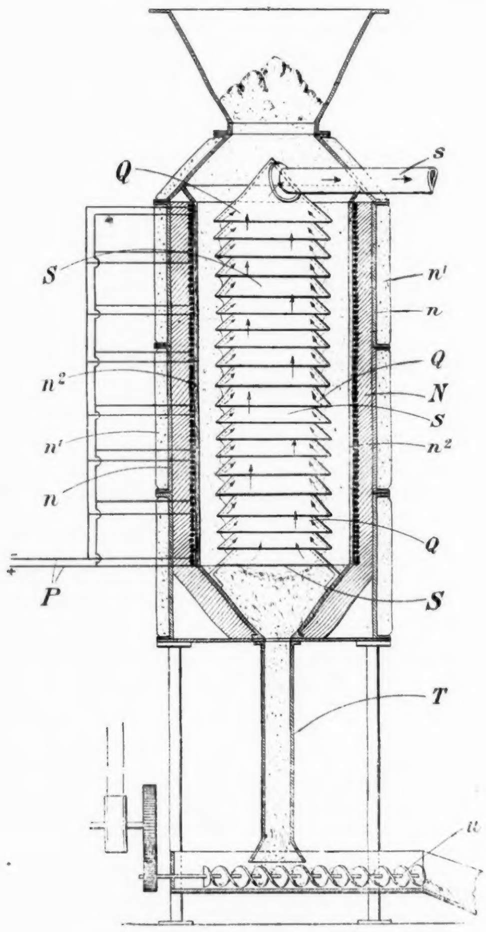
AT THE FIRST MEETING OF CREDITORS at Birmingham last week of Phineas Keats, a chemist, who was remanded on bail in connection with a charge of obtaining large sums by false pretences, it was stated that the total proofs amounted to £73,537. The greater part of the amount related to money advanced to the debtor on agreement to receive a half-share of profits. The Official Receiver declared that under the Bankruptcy Act these claims could not be admitted until other creditors had been paid in full.

Patent Literature

Abstracts of Complete Specifications

149,366. ARSENIOUS ORES, TREATMENT OF. H. J. Wilson, 60, Russell Square, London. Application date, Jan. 3, 1919.

Arsenious ores are roasted in two operations, the first in a portable roasting plant at the place where the ore is obtained, and the second in an electrically-heated refining apparatus at a central station. The ore is first crushed and then conveyed to the top of a pre-heating tower having a central flue, through which the flue gases and the volatilised arsenious oxide pass upwards from the roasting chamber. The ore passes downwards through the annular space surrounding the central flue, and is thereby pre-heated to a temperature of about 450°C. The ore then passes into the rotary furnace, which is slightly



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inclined downwards at such an angle that the ore passes through it in about 90 to 100 revolutions. The furnace is heated by gas from a producer, and the gases which leave it to pass into the pre-heating tower are pyrometrically controlled to a temperature of 520°C. The spent ore then passes into a rotary chamber of the same dimensions as the furnace, through which the air is passed to pre-heat it to 350°C. The volatilised arsenious oxide is collected in a condenser and then conveyed to the refining apparatus shown in the illustration. A vertical cylinder, *N*, is built up of metal sections, *n*, covered externally and internally with firebrick, *n'*, and having an inner lining, *n²*, of vitreosil or fused quartz. The furnace is heated by surrounding coils of nickel chrome wire, *o*, connected in sections, to the electric mains, *p*. A series of quartz rings, *Q*, having their sides at an angle of 45 deg., are arranged one above the other as shown, so as to form a series of annular louvres with a central duct, *S*. The arsenious oxide, *R*, is volatilised continuously while passing downwards, and the vapour passes out through a pipe, *s*, to the condensers. Any residual solid matter passes downwards through a pipe, *T*, sufficiently long to form an atmospheric seal, and is then removed by a helical conveyor, *u*, of quartz.

149,374. STARCH AND CONVERSION PRODUCTS THEREOF, METHOD OF MANUFACTURING, AND THE PRODUCTS OBTAINED THEREFROM. A. W. H. Lenders, 2101, Grand Avenue, Cedar Rapids, Iowa, U.S.A. Application date, March 5, 1919.

The process is for manufacturing starch and products such as glucose syrup and grape sugar. In the usual method of manufacturing starch—*e.g.*, from Indian corn—the product which is finally obtained by "tabling" the starch and protein on inclined planes usually contains a residuum of protein matter of 0·5 per cent. This does not affect the value of starch in ordinary use, but is detrimental when it is used for making conversion products, such as glucose syrup and grape sugar by acid hydrolysis. The protein impurities produce a discoloration of the liquor, and prevent the complete conversion of the starch, and hinder the complete crystallisation of the resulting sugar. The object is to eliminate the protein impurities. This is effected by rendering these impurities soluble by treating the starch-bearing material with a selected culture of proteolytic bacteria (which are without effect on the starch. Preferably the bacteria used are members of the *bacillus putrificus* group, more particularly B. No. 121·1233111, according to the descriptive chart of the Society of American Bacteriologists, endorsed by the Society for general use December 31, 1907. The temperature is maintained at 100°F. to 105°F., and the starch obtained by decanting the liquor, the process being repeated if necessary.

149,398. LIQUID FUEL, PROCESS OF PRODUCING, AND PRODUCT THEREOF. E. C. R. Marks, London. (From U.S. Industrial Alcohol Co., 27, William Street, New York.) Application date, May 7, 1919.

The process is for producing a fuel composed of ethyl alcohol, one or more light hydrocarbons and acetylene. Calcium carbide is added to ethyl alcohol, and the contained water is acted upon to produce acetylene, part of which dissolves in the alcohol while the remainder is conveyed away and passed into a mixture of gasolene and kerosene. The dehydrated alcohol containing acetylene is filtered off from the calcium hydroxide and carbide, and mixed with the gasolene and kerosene, which have been enriched with acetylene.

149,428. DYESTUFFS CONTAINING THE SULPHONAMIDE GROUP, APPLICATION OF TO DYEING AND PRINTING. J. W. McMyn, Roslyn, Hollins Lane, Accrington, Lancs., Application date, May 13, 1919.

The dyes used are those containing the sulphonamide group SO_2NH_2, or SO_2NHR (where R is methyl, ethyl, phenyl, or other hydrocarbon radical), but not containing a sulphonic or carboxylic acid group. The dyes are obtained by coupling a diazotised aminophenylsulphonamide or aminotolylsulphonamide with an amine or phenol. These dyes are insoluble in water or in alkalies, such as sodium carbonate or ammonia, but soluble salts are formed with caustic alkalies. The colour is precipitated from its solution by carbon dioxide, bicarbonates, ammonium salts, weak acids or alum. The material to be dyed is treated with a solution in caustic alkali, any suitable thickener being added, and the dye is fixed on the fibre, preferably by alum.

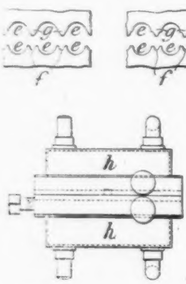
149,453. ALUMINOUS MATERIALS, CONVERSION OF POWDERED INTO GRANULAR FORM. J. J. Hood, 4, Canonbury Park North, Islington, London. Application date, May 20, 1919.

The object is to produce granulated alumina from the trihydrate, bauxite, or other powdered aluminous material, in a granular form suitable for filtering mineral oils. The

material is made into a paste with nitric acid, heated to expel free acid, and further heated to decompose partly the aluminium nitrate. The material is then crushed and graded, and finally raised to dull red heat to decompose the remaining nitrate and harden the grains.

149,477. MOULDS FOR CASTING CHEMICAL AND OTHER STICKS. T. Tucker, Stirling Chemical Works, Stratford, Essex. Application date, May 31, 1919.

The two halves of the moulds used for casting chemical sticks are liable to warp and allow material to escape. To avoid this,



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longitudinal grooves, *f*, are provided between the adjacent moulds, *e*, and register with ridges, *g*, on the other half of the mould. The two halves are thus locked in position. A cooling jacket, *h*, through which water is circulated may be provided on each half of the mould.

149,553. AZO-DYESTUFFS AND INTERMEDIATE PRODUCTS THEREFOR, MANUFACTURE OF. O. Imray, London. (From Society of Chemical Industry in Basle, Switzerland.) Application date, May 12, 1919.

Naphthalene-disulpho-carboxylic acids which have a sulpho group in 1 position are nitrated in their free 8 position by sulphuric and nitric acids, and reduced by iron filings. The amido group is exchanged for the hydroxyl group in known manner, and the product partly fused with alkali; hydrochloric acid is added and 1 : 8 dioxynaphthalene-sulphocarboxlyic acids are obtained. These acids are so constituted that on coupling the azo group enters the 2 or 7 position without elimination of the carboxyl group. Examples are given and the method of using the deyestuffs is described.

International Specifications Not yet Accepted

146,092. CELLULOSE ESTERS. Soc. Chimique des Usines du Rhone, Anciennement Gilliard, P. Monnet, et Cartier, 89, Rue de Miromesnil, Paris. International Convention date, June 20, 1919.

Cellulose is treated with small quantities of acetic anhydride in presence of a catalyst diluted with glacial acetic acid at a temperature below 30°C. A further quantity of acetic anhydride is then added, and the mixture raised to 40°C. The esters are separated by precipitation with water, or they may be partly saponified into esters having different solubilities.

146,097. FERTILISERS. Nitrum Akt.-Ges., 30, Bahnhofstrasse, Zurich, and H. Schellenberg, Personico, Tessin, Switzerland. International Convention date, June 28, 1919.

Tricalcium phosphate is heated with an equal quantity of 50-60 per cent. nitric acid to convert it into mono-calcium phosphate and calcium nitrate. Limestone or phosphate is then added to neutralise the free acid, and the product is allowed to solidify and is pulverised for use as a fertiliser.

146,110-4. METHANE. Farbwerke vorm. Meister, Lucius & Bruning, Hoechst-on-Main, Germany. International Convention date, June 28, 1919, and July 1, 1919.

146,110. Carbon monoxide and an excess of hydrogen are passed through a series of furnaces containing heated pumice coated with nickel, the carbon monoxide being replenished at each passage, so that it does not exceed 20 per cent. of the hydrogen. Water vapour is removed after each passage, and the methane is obtained by liquefaction.

146,114. This is an addition to 146,110. When a high concentration of methane has been obtained in the later stages, carbon dioxide is added to the reacting mixture instead of carbon monoxide, and any excess is finally removed by lime and the hydrogen by heated cupric oxide.

146,127. HEATING IN VACUO. Allgemeine Ges. für Chemische Industrie, 35, Unter den Linden, Berlin. International Convention date, March 13, 1919.

A chamber for conducting high-temperature reactions *in vacuo* is provided with a removable cover which is sealed by a flange on the cover fitting into a groove in the casing and made gas tight by a fusible material having a melting point above the temperature attained in the reaction. The seal may be removed by re-melting or chipping away.

146,133. CALCIUM ALUMINATE. Soc. Electro-Metallurgique Française, 28, Rue de Madrid, Paris. International Convention date, March 7, 1916.

A mixture of bauxite and limestone is coarsely crushed and heated in a rotary furnace to a temperature which does not cause fritting, and the mixture then fused in another furnace. Calcium aluminate is thus produced. When red bauxite containing ferric oxide is used, a blast furnace may be employed and pig iron is obtained in addition.

146,141-5. SULPHUR. Farbenfabriken vorm. F. Bayer & Co., Leverkusen, near Cologne. International Convention date, May 24, 1917, and July 3, 1918.

146,141. Sulphuretted hydrogen or gases, such as coal gas, which contain it, are mixed with air, oxygen, or sulphur dioxide, and passed over vegetable or animal charcoal at ordinary temperature. Sulphur is precipitated on the carbon.

146,145. This is an addition to 146,141. If only a small proportion of sulphuretted hydrogen is present, a small quantity of ammonia or an amine is added to facilitate the oxidation. In the case of coal gas, sufficient ammonia is already present.

146,159. PHENOL-ALDEHYDE CONDENSATION PRODUCTS. L. V. Redman, A. J. Weith and F. P. Brock, 626, West 22nd Street, Chicago. International Convention date, June 6, 1918.

The object is to produce a moulded phenolic condensation product. An anhydrous fusible phenolic resin is mixed with a phenol, a methylene compound such as hexamethylenetetramine, and a fibrous filler such as asbestos. The mixture is moulded and then subjected to prolonged heat treatment to produce a hard infusible product. The fusible resin may be obtained by heating a mixture of cresol and hexamethylenetetramine, blowing off part of the excess cresol, adding creosote oil and hexamethylenetetramine, cooling, and pulverising. The ingredients of the phenolic resin may be employed instead of the prepared resin.

144,166-7; 146,180-1-2. SYNTHETIC TANNING AGENTS. Gerb- und Farbstoffwerke H. Renner & Co., Akt.-Ges., 20, Billhorner, Canelstrasse, Hamburg, Germany. International Convention dates, February 16, 1914, and July 7, 1915; February 28, 1914; November 12, 1918; and November 21, 1918.

144,166. A resinous sulphonated condensation product is obtained by heating a mixture of a hydrocarbon, excess of sulphuric acid, and a condensation-promoting agent such as formaldehyde, ketones, phosphoryl chloride, or thionylchloride. Examples are given.

144,167. Sulphonated condensation products from hydrocarbons or phenols are treated with oxidising agents such as oxygen, hydrogen peroxide, potassium bichromate, or other highly oxidised salts. The products may be rendered water-soluble by mixing with soluble tanning agents. Examples are given.

146,180. Addition to 146,166. Waste acid resins of mineral oil refinery are mixed with naphthalene in amount corresponding to the sulphuric acid in the resin, and with condensation-promoting agents such as formaldehyde, phosphorous oxychloride, ketones or thionyl chloride, and heated to produce a soluble sulphonated condensation product.

146,181. Addition to 146,167. Acid resin or acid tar from mineral oil refining is treated with monochromates of barium, sodium or potassium equivalent to the free acid, or alternatively with hydroxides or carbonates of chromium, aluminium, or iron.

146,182. Addition to 146,167. Acid resin or acid tar from mineral oil refining is treated with chromates, bichromates, or chromic acid. Any free sulphuric acid remaining may be neutralised with alkali or alkaline earths.

146,183. DISTILLING TAR. A. Irinzi, 54, Mittleweg, Hamburg, Germany. International Convention date, November 25, 1918.

Tar is supplied from a reservoir to a retort, the vapour being returned to the reservoir, and the residual pitch discharged, all the operations being continuous. When the requisite temperature is reached in the reservoir the distillate is drawn off from it.

146,212. CELLULOSE ACETATE COMPOSITIONS. British Cellulose and Chemical Manufacturing Co., Ltd., 8, Waterloo Place, London. (*Assignees of G. W. Miles, Sandwich, Mass., U.S.A.*). International Convention date, June 30, 1919.

A composition for making artificial silk, films, or varnish, consists of cellulose acetate and the aggregate of fatty acids extracted from coconut oil, together with a volatile solvent.

146,214-8. TANNING AGENTS. O. Rohm, 4, Weiterstadterstrasse, Darmstadt, Germany. International Convention dates, December 27, 1918, and April 11, 1919.

146,214. When ferrous sulphate is acted upon by chlorine a salt having the formula $FeSO_4Cl$ is produced and is suitable as a tanning agent. If crystals of ferrous sulphate are treated a crystalline compound having the formula $FeSO_4Cl.6H_2O$ may be obtained.

146,218. Addition to 146,214. The crystalline compound last mentioned is obtained by evaporating its solution under reduced pressure until the water content corresponds with the formula, and then cooling.

146,222. CLEANING COMPOSITIONS. F. M. Mayrhafer, 69, Greisenaustrasse, Berlin. International Convention date, May 27, 1919.

A mixture of anhydrous or hydrated aluminium sulphate is described which, when water is added, contains aluminium hydroxide in gel form. The compound is suitable as a cleaning composition.

146,223-4. CLEANING COMPOSITIONS. E. Reinfurth, 9, Herrfurthstrasse, Dahlen, Berlin. International Convention dates, July 31, 1916, and March 5, 1918.

146,223. Soap is mixed with salts of α and β-naphthalene monosulphonic acids, *e.g.*, the alkaline or ammonium salts, with or without clay.

146,224. Addition to 146,223. Lathering detergents are composed of soluble salts of α or β-naphthalene monosulphonic acid which may be mixed with soda, potash, water glass, clay, kieselguhr, or glauber salts.

146,227. NITROGEN OXIDES FROM AMMONIA. H. Frischer, 4, Paulstrasse, Zehlendorf, Germany. International Convention date, November 23, 1916.

When ammonia is oxidised by combustion, the ammonium nitrate and nitrite and ammonia contained in the combustion products are extracted by sulphuric or phosphoric acid, or by bisulphates before the gases pass into the absorption apparatus.

146,231. FILTERS. United Filters Corporation, 65, Broadway, New York. (*Assignees of O. J. Salisbury, Felt Building, Salt Lake City, Utah, U.S.A.*). International Convention date, May 24, 1917.

A horizontal hollow shaft carries a number of hollow disc filters, each dipping into a separate narrow tank, which contains the liquid to be filtered. Each disc is built up of a number of segments covered with fabric. Suction is supplied to the interior of the discs and the hollow shaft, and the filtrate is discharged through the shaft, which is divided into segments corresponding to the disc segments. Solid matter is removed from the discs by scraping, and the discs may be cleaned by spraying with water.

146,234. GALLOLACTATES AND TANNOLACTATES. E. Kolshorn, 39, Ehrenbergstrasse, Dahlen, Berlin. International Convention date, June 13, 1919.

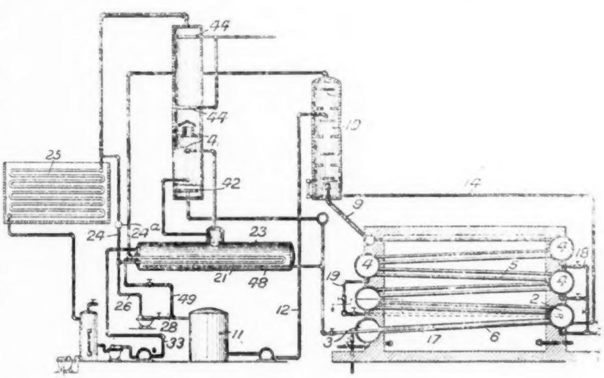
Normal lactates of alkaline earth metals, magnesium, or aluminium, are heated with gallic, tannic or gallotannic acid, or basic tannates or gallates with lactic acid in dilute alcohol or acetone. Gallolactates and tannolactates having therapeutic properties are produced.

146,238. WET-SEPARATING APPARATUS. A. Mueller, 21 Junkerstrasse, Munster, Westphalia, Germany. International Convention date, February 10, 1919.

Mixed materials having different specific gravities are separated by a liquid medium of intermediate specific gravity. The separated materials are discharged from different levels in the tank by two inclined conveyors rotating in opposite directions. Coal, coke, furnace residues, waste materials, &c., may be treated, by means of salt solutions, lyes, dilute molasses, or suspensions of clay, lime, chalk, &c.

146,251. CRACKING HYDROCARBONS. R. H. Brownlee, 1902, Benedum-Trees Building, Pittsburg, U.S.A. International Convention date, July 11, 1917.

Hydrocarbon oil passes by a pipe 14 to a drum 2, and steam, hydrogen, or a hydrocarbon gas is also passed into the drum through the lowest tube 6 of a series of externally heated tubes connecting a series of drums 2, 3, 4. The vapour passes by a pipe 9 to a column 10 where it is clarified and pre-heats the oil



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supply. The vapour then passes through pipes 21 in stills 23, where it is partly condensed and passes to the tank 11, and thence by pipe 12 to column 10. The uncondensed vapour passes through a pressure regulating valve 24^a to a condenser 25, from which the liquid passes to the stills 23, where it is distilled by the hot pipes 21 and by steam from a perforated pipe 48. The vapour passes through a dephlegmator 41, having heating and cooling coils 42, 44, to the condenser.

Specifications Accepted, with Date of Application

129,971. Gas-producers. A. L. Galusha. July 15, 1918.
132,529. Acetic acid from acetylene as the primary material. Catalytical processes for preparing. Soc. des Acieries et Forges de Firminy. March 13, 1918.
144,256. Apparatus for conveying and delivering materials. F. L. Stuart. May 31, 1919.
150,068. Drying-processes and apparatus therefor. T. Boberg and Techno-Chemical-Laboratories, Ltd. May 27, 1919.
150,113. Water concentration of ores. W. M. Martin. June 16, 1919.
150,116. Aluminous materials, process for purifying. Carborundum Co. (*O. Hutchins.*) June 18, 1919.
150,127. Nitrogen, apparatus for the fixation of. E. C. R. Marks. (*Nitrogen Products Co.*) June 23, 1919.
150,157. Kilns. W. Somerville. July 23, 1919.
150,214. Hypochlorites, electrolytic apparatus for the direct production of. P. Pestalozza. December 19, 1919.

LATEST NOTIFICATIONS.

150,329. Method of producing fast dyeings on cotton and like fibres. Farbwerke vorm. Meister, Lucius, and Bruning. May 30, 1914.
150,349. Method and apparatus for indicating level of liquids. Merrick, A. A. August 25, 1919.
150,708. Alkylene cyanhydrines. Rohm and Haas. September 3, 1919.
150,709. Manufacture of a colour of the anthraquinone series. Cassella & Co., 4, September 1, 1919.

Applications for Patents

Atmosteral Ltd. (Dunsford, F. T.). Antiseptics, disinfectants, &c. 26,086. September 10.
Badische Anilin-& Soda- Fabrik (Johnson, J. Y.). Manufacture of fertilisers. 25,892. September 8.
Barker, J. T. Electrolytic cells for production of chlorate of alkali metals. 26,104. September 10.
Barrett Co. Manufacture of resins. 25,811. September 7. (United States, March 8.)
Bate, S. C. and Dexter, J. Utilisation of chlor-picrin. 25,773. September 7.
Claessen, C. Manufacture of gelatinous explosives. 25,802. September 7. (Germany, April 22).
Claude), Soc. l'Air Liquide, (Soc. Anon. pour l'Etude et l'Exploitation des Procédés G. *See* Soc. l'Air, &c.
Deerr, N. Recovery of alcohol and concentrated "slop" from fermented materials. 26,159. September 11.
Dulac, A. Process for transforming liquid fuel into solid fuel. 25,908. September 8.
Goldschmidt Akt.-Ges., T. Production of alkali sulphate and hydrochloric acid. 26,001. September 9. (Germany, September 9, 1919.)
Gouin, P. Alkaline storage batteries. 25,999. September 9. (France, September 10, 1919.)
Herriott, W. S. (*Deerr*). Recovery of alcohol and concentrated "slop" from fermented materials. 26,159. September 11.
Kay, A. Apparatus for heating liquids, &c. 25,925. September 9.
Lajoux, A. G. and Lemoine, E. A. Process for transforming liquid fuel into solid fuel. 25,908. September 8.
McKean, J. G. Liquid-fuel apparatus. 26,121. September 11.
Maclean, A. D. and Lloyd, D. R. Manufacture of cement. 26,017. September 10.
Middleton, T. P. Production of three-colour heliochromes. 25,620. September 6.
Morgan, J. S. Method of immersing subdivided solids or liquids in liquids. 25,804. September 7.
Pfannenschmidt, P. L. Acid chambers, acid towers, acid mains, &c. 25,585. September 6. (Germany, September 8, 1919.)
Sander, H. A. Production of synthetic alcohol. 25,738. September 7.
Soc. Anon. d'Applications des Gaz Liquéfiés. Closing device for receptacles for compressed or liquefied gases. 25,989. September 9. (France, April 13.)
Soc. d'Etudes Chimiques pour l'Industrie. Conversion of cyanamide into urea. 25,336. September 2. (Switzerland, September 26, 1919.)
,, Manufacture of manure containing nitrogen and phosphate. 25,337, 25,338. September 2. (Switzerland, September 26, 1919.) 25,340. September 2. (Switzerland, November 25, 1919.)
,, Manufacture of manure containing nitrogen and fertilising salts. 25,341 September 2. (Switzerland, November 25, 1919.)
Soc. d'Etudes Chimiques pour l'Industrie. Manufacture of a nitrophosphate manure. 25,344. September 2. (Switzerland March 2.)
,, Preparation of a nitrogen manure. 25,345. September 2. (Switzerland, March 2.)
Soc. l'Air Liquide (Soc. Anon. pour l'Etude et l'Exploitation des Procédés G. Claude). Direct systhesis of ammonia. 25,766. September 7. (France, September 8, 1919.)
Surpass Chemical Co. Process of dyeing. 26,079. September 10. (United States, January 30.)
Thermal Industrial & Chemical (T. I. C.) Research Co. Method of immersing subdivided solids or liquids in liquids. 25,804. September 7.
United Alkali Co. (*Barker*). Electrolytic cells for production of chlorates of alkali metals. 26,104. September 10.
Wilson, H. J. Distillation of carbonaceous materials and shales. 26,114. September 10.
Zack, M. Separating oxygen and nitrogen. 25,423. September 3. (Switzerland, October 15, 1919.)
,, Raising liquids easily evaporating at low temperature and standidg under low pressure. 25,424. September 3. (Switzerland, October 10, 1919.)

U.S. Soda Ash Production

Statistics for 1919

THE statistics relating to the production of soda ash in the United States during the year 1919, recently published by the United States Geological Survey, direct attention to the influence of electrolytic methods of caustic soda manufacture upon the chemical procedure hitherto relied upon for its production by the causticisation of soda ash.

The following figures show the growth of soda ash production in the United States for five-year periods prior to 1914, and annually since 1916 and including 1919 :—

	Quantity (short tons).	Value.		Quantity (short tons).	Value.
1899	390,653	$4,859,656	1916...	1,194,183	$16,464,774
1904	518,954	8,204,545	1917...	1,390,625	38,028,000
1909	646,057	10,362,656	1918...	1,390,628	35,635,520
1914	935,305	10,937,945	1919...	981,354	29,824,245

Mr. Walter Weldon, well known in connection with the Le Blanc process, in 1883 estimated the entire annual soda trade (carbonate and hydrate in terms of carbonate) of the world to be about 709,000 tons. Comparison of this estimate made 37 years ago with 1919 soda ash production in America alone indicates the rapid progress of the chemical and allied industries and reflects the transformation in civilisation wrought by this compound.

The following firms are the most prominent producers of soda ash in the United States, reducing salt by chemical means in contradistinction to electrolytic methods yielding directly caustic soda: Solvay Process Co., Suracuse, New York, Detroit, Michigan, Hutchinson, Kansas; Mathieson Alkali Works, Inc., Saltville, Va.; Diamond Alkali Co., Alkali, near Painesville, Ohio; and Columbia Chemical Co., Barberton, Ohio.

The soda ash production statistics given above are notable in the history of heavy chemical manufacture, in that they indicate the peak of production by chemical processes of this essential commodity, and reflect the inevitable restriction imposed by the electrolytic cell on such manufacturing expansion as may be represented by that portion of the product that hitherto has been causticised to obtain the hydrate. The degree to which such restriction as these figures represent may be progressive, in turn is limited by the outlet for the chlorine of the electrolytic cell.

The remoteness of the time when the alkali industry must depend for its existence upon soda ash production alone will be determined, on the one hand, by cheap power and convenient salt accessible to markets for electrolytic products; and, on the other, by a consumption outlet for the chlorine, which is produced in equal amounts with caustic soda in the electrolysis of salt.

The exports of soda ash in 1919 amounted to 50,481 short tons, valued at $2,656,608. This material was shipped principally to Canada, Brazil, Sweden, Mexico and Australia, named in order of decrease in quantity exported. The imports amounted to only 415 short tons, valued at $12,998.

The new sulphuric acid plant of the Texas Chemical Co., at Manchester, Texas, which has a capacity of 100 tons of acid daily, is now in operation. Only seven months elapsed from the time the site was inspected until the plant was in operation.

German Trade in China

According to the *Frankfurter Zeitung*, the GERMAN TRADE POSITION IN CHINA has shown a slow but steady improvement. Germany is again beginning to prove her supremacy everywhere in the chemical industry. During the months of April, May and June alone, it is stated that Germany has delivered more aniline dyes than England has in six months.

Books Received

DEBENTURES. By Herbert W. Jordan. Ninth edition. London: Jordan & Sons, Ltd. Pp. 65. 1s. 6d. net.
MARGARINE. By William Clayton. (Illustrated.) London: Longmans, Green & Co. Pp. 187, 14s. net.
THE MANUFACTURE OF SUGAR FROM THE CANE AND BEET. By T. H. P. Heriot. (Illustrated.) London: Longmans, Green & Co. Pp. 426. 24s. net.

Monthly Market Report and Current Prices

Our Market Report and Current Prices are exclusive to THE CHEMICAL AGE, *and, being independently prepared with absolute impartiality by Messrs. R. W. Greeff & Co. and Messrs. Chas. Page & Co., Ltd., may be accepted as authoritative. The prices given apply to fair quantities delivered ex wharf or works, except where otherwise stated. The weekly report contains only commodities whose values are at the time of particular interest or of a fluctuating nature. A more complete report and list are published once a month. The current prices are given mainly as a guide to works managers, chemists, and chemical engineers; those interested in close variations in prices should study the market report.*

Market Report

WEDNESDAY, September 15.

It is difficult to detect any outstanding feature upon which to comment since last week. Generally speaking the demand for chemicals is exceedingly slow, and the whole situation is overshadowed by the impending troubles with labour. If these troubles can be adjusted, the end of the holiday season should make for a general improvement in demand. Stocks are not high, and given industrial peace, a resumption of buying activities within a comparatively short time is inevitable.

There has been a good export enquiry for certain heavy Chemicals, but otherwise that market is patchy. The exchange situation does not tend to increase business.

General Chemicals

ACETONE passes steadily into consumption at recent rates.

ACID ACETIC.—Quite a good business is reported, both for prompt delivery and early arrival. The spot price is firmly maintained, and stocks are now a good deal lighter than has been the case recently.

ACID CARBOLIC remains a weak market with little doing.

ACID CITRIC is in limited enquiry, but exporters hold firmly to their prices.

ACID FORMIC is in good demand, and is firm in tone.

ACID OXALIC has not been very much enquired for, and is quietly easy.

ACID TARTARIC is unchanged, and only a slow market.

BLEACHING POWDER is in good demand for export, but nothing is obtainable from the makers for prompt delivery.

COPPER SULPHATE is in a hopeless condition and practically no business is passing.

FORMALDEHYDE is in quiet demand, and exhibits an easy tone.

LEAD SALTS.—Little business is passing, and several of the makers have closed their plant.

POTASSIUM PERMANGANATE.—Important stocks have been cleared, and the article shows a firmer tendency.

POTASSIUM PRUSSIATE is only in quiet demand, and price is unchanged.

SODIUM CAUSTIC.—Owing to realizations of secondhand parcels there is a weaker tone, particularly as the export demand is poor.

SODA BICHROMATE is cheaper in second hands, and rather more seems to be available.

SODA NITRITE is distinctly firmer, and makers report difficulties in regard to supplies of soda and coal.

SODA PHOSPHATE.—Makers have advanced their prices, but there are still parcels available in secondhands at the old rates.

SODA PRUSSIATE.—The English makers' price which was reduced last week is maintained at a lower level, and only moderate business is reported.

ZINC SALTS are without feature, but there has been a fair amount of business passing for chloride.

Coal Tar Intermediates

There is little of interest to note in this section. Only a very small amount of new business has been placed, but on the whole markets continue steady and prices firm. Manufacturers being in most cases well sold ahead show little inclination to quote lower prices for forward positions.

ALPHA NAPHTHYLAMINE.—This article is in better request, and price is without change.

ALPHA NAPHTHOL is well maintained in value, and prompt delivery cannot be obtained.

BETANAPHTHOL is inclined to be a shade easier, owing to one or two arrivals of foreign material. The undertone, however, is quite firm.

DIMETHYLANILINE is quoted at slightly lower rates for arrival, but little interest is being taken in the product just at the moment.

PARANITRANILINE is in quietly steady request, and the price is firmly maintained.

PARAPHENYLENE DIAMINE has been wanted, and makers hold strongly to their prices.

RESORCIN has been enquired for, but little is available for near delivery.

Coal Tar Products

There is little change to report in our market, the only feature being shortage of supplies of Benzol.

90's BENZOL is quoted 3s. 9d. to 3s. 10d. per gallon on rails in the North, and 3s. 10d. to 3s. 11d. in the South.

PURE BENZOL is worth about 4s. a gallon.

CREOSOTE OIL remains unchanged at 1s. 1d. to 1s. 1½d. in the North, and 1s. 2d. to 1s. 2½d. in the South.

CRESYLIC ACID is slightly more active, although prices remain unchanged at 4s. to 4s. 2d. per gallon for the dark 95/97 per cent. quality, and 4s. 7d. to 4s. 10d. per gallon for the pale 97/99 per cent. quality.

SOLVENT NAPHTHA.—Business is being done at 3s. per gallon on rails.

HEAVY NAPHTHA remains unchanged at 3s. 6d. per gallon.

NAPHTHALENE.—The crude qualities are scarce, and in good demand, and prices, which have an upward tendency, are £16 to £25 per ton. Refined is not quite so active, although the prices remain in the region of £50 to £55 per ton.

PITCH.—The position remains unchanged, prices still being about 220s. f.o.b. London to 225s., and 210s. to 215s. f.o.b. East Coast.

Sulphate of Ammonia

There is no change to report.

Current Prices

Chemicals

	per	£	s.	d.		£	s.	d.
Acetic anhydride	lb.	0	3	9	to	0	4	0
Acetone oil	ton	90	0	0	to	95	0	0
Acetone, pure	ton	120	0	0	to	125	0	0
Acid, Acetic, glacial, 99-100%	ton	105	0	0	to	110	0	0
Acetic, 80% pure	ton	87	10	0	to	90	0	0
Arsenic	ton	100	0	0	to	105	0	0
Boric, cryst.	ton	74	10	0	to	76	0	0
Carbolic, cryst. 39-40%	lb.	0	1	0½	to	0	1	1
Citric	lb.	0	4	6	to	0	4	9
Fluoric	lb.	0	0	7½	to	0	0	8
Formic, 80%	ton	115	0	0	to	120	0	0
Gallic, pure	lb.		7	6	to	0	7	9
Hydrofluoric	lb.	0	0	7½	to	0	0	8
Lactic, 50 vol.	ton	58	0	0	to	60	0	0
Lactic, 60 vol.	ton	72	10	0	to	75	0	0
Nitric, 80 Tw.	ton	41	0	0	to	44	0	0
Oxalic	lb.	0	2	4	to	0	2	5
Phosphoric, 1.5	ton	65	0	0	to	67	0	0
Pyrogallic, cryst	lb.	0	11	6	to	0	11	9
Salicylic, Technical	lb.	0	2	3	to	0	2	6
Salicylic, B.P.	lb.	0	3	1	to	0	3	2
Sulphuric, 92-93%	ton	8	10	0	to	8	15	0
Tannic, commercial	lb.	0	3	6	to	0	3	9
Tartaric	lb.	0	3	1	to	0	3	2
Alum, lump	ton	19	10	0	to	20	0	0
Alum, chrome	ton	92	0	0	to	93	0	0
Alumino ferric	ton	9	0	0	to	9	10	0
Aluminium, sulphate, 14-15%	ton	17	10	0	to	18	10	0
Aluminium, sulphate, 17-18%	ton	20	10	0	to	21	10	0
Ammonia, anhydrous	lb.	0	2	2	to	0	2	4
Ammonia, .880	ton	43	0	0	to	45	0	0
Ammonia, .920	ton	30	0	0	to	32	10	0
Ammonia, carbonate	lb.	0	0	7½	to		—	

	per	£	s.	d.		£	s.	d.
Ammonia, chloride	ton	100	0	0	to	105	0	0
Ammonia, muriate (galvanisers)	ton	60	0	0	to	65	0	0
Ammonia, nitrate	ton	65	0	0	to	70	0	0
Ammonia, phosphate	ton	120	0	0	to	125	0	0
Ammonia, sulphocyanide	lb.	0	3	0	to	0	3	3
Amyl acetate	ton	420	0	0	to	425	0	0
Arsenic, white, powdered	ton	74	0	0	to	76	0	0
Barium, carbonate, 92-94%	ton	12	10	0	to	13	0	0
Barium, chlorate	lb.	0	0	11	to	0	1	0
Chloride	ton	32	0	0	to	33	0	0
Nitrate	ton	55	0	0	to	56	0	0
Barium Sulphate, blanc fixe, dry	ton	28	10	0	to	30	0	0
Sulphate, blanc fixe, pulp	ton	16	10	0	to	17	0	0
Sulphocyanide, 95%	lb.	0	1	6	to	0	1	8
Bleaching powder, 35-37%	ton	28	0	0	to	29	0	0
Borax crystals	ton	41	0	0	to	42	10	0
Calcium acetate, Brown	ton	20	0	0	to	21	0	0
,, Grey	ton	34	0	0	to	35	10	0
Calcium Carbide	ton	30	0	0	to	32	0	0
Chloride	ton	9	10	0	to	10	10	0
Carbon bisulphide	ton	65	0	0	to	67	0	0
Casein, technical	ton	75	0	0	to	80	0	0
Cerium oxalate	lb.	0	3	9	to	0	4	0
Chromium acetate	lb.	0	1	2	to	0	1	4
Cobalt acetate	lb.	0	8	6	to	0	9	0
Oxide, black	lb.	0	10	0	to	0	10	3
Copper chloride	lb.	0	1	3	to	0	1	6
Sulphate	ton	41	0	0	to	42	0	0
Cream Tartar, 98-100%	ton	245	0	0	to	250	0	0
Epsom salts (*see* Magnesium sulphate)								
Formaldehyde 40% vol.	ton	315	0	0	to	320	0	0
Formusol (Rongalite)	lb.	0	5	0	to	0	5	6
Glauber salts	ton	Nominal.						
Glycerine, crude	ton	70	0	0	to	72	10	0
Hydrogen peroxide, 12 vols.	gal.	0	2	9	to	0	2	10
Iron perchloride	ton	50	0	0	to	52	0	0
Iron sulphate (Copperas)	ton	4	0	0	to	4	5	0
Lead acetate, white	ton	85	0	0	to	87	10	0
Carbonate (White Lead)	ton	65	0	0	to	67	10	0
Nitrate	ton	55	0	0	to	57	0	0
Litharge	ton	57	0	0	to	59	0	0
Lithopone, 30%	ton	50	0	0	to	51	0	0
Magnesium chloride	ton	15	10	0	to	16	10	0
Carbonate, light	cwt	2	15	0	to	3	0	0
Sulphate (Epsom salts commercial)	ton	13	10	0	to	14	0	0
Sulphate (Druggists')	ton	18	10	0	to	19	10	0
Manganese, Borate	ton	19	0	0	to	—		
Sulphate	ton	100	0	0	to	105	0	0
Methyl acetone	ton	95	0	0	to	100	0	0
Alcohol, 1% acetone	gall.	Nominal.						
Nickel sulphate, single salt	ton	60	0	0	to	62	0	0
Nickel ammonium sulphate, double salt	ton	62	0	0	to	64	0	0
Potassium bichromate	lb.	0	1	10½	to	0	1	11
Carbonate, 90%	ton	115	0	0	to	120	0	0
Chloride	ton	50	0	0	to	52	0	0
Chlorate	lb.	0	0	9½	to	0	0	10½
Meta-bisulphite, 50-52%	ton	260	0	0	to	270	0	0
Nitrate, refined	ton	65	0	0	to	67	0	0
Permanganate	lb.	0	4	0	to	0	4	3
Prussiate, red	lb.	0	4	3	to	0	4	6
Prussiate, yellow	lb.	0	2	0	to	0	2	1
Sulphate, 90%	ton	31	0	0	to	33	0	0
Salammoniac, firsts	cwt.	5	10	0	to	—		
Seconds	cwt.	5	5	0	to	—		
Sodium acetate	ton	59	0	0	to	61	0	0
Arsenate, 45%	ton	60	0	0	to	62	0	0
Bicarbonate	ton	10	10	0	to	11	0	0
Bichromate	lb.	0	1	4	to	0	1	5
Bisulphite, 60-62%	ton	50	0	0	to	52	10	0
Chlorate	lb.	0	0	5	to	0	0	5½
Caustic, 70%	ton	32	0	0	to	33	0	0
Caustic, 76%	ton	38	10	0	to	39	0	0
Hydrosulphite, powder, 85%	lb.	0	4	0	to	0	4	6
Hyposulphite, commercial	ton	35	10	0	to	37	10	0
Nitrite, 96-98%	ton	87	10	0	to	90	0	0
Phosphate, crystal	ton	47	0	0	to	49	0	0
Perborate	lb.	0	2	2	to	0	2	4
Prussiate	lb.	0	1	2½	to	0	1	3½
Sulphide, crystals	ton	30	0	0	to	32	0	0
Sulphide, solid, 60-62%	ton	55	0	0	to	57	0	0
Sulphite, cryst	ton	15	10	0	to	16	10	0
Strontium carbonate	ton	85	0	0	to	90	0	0
Nitrate	ton	90	0	0	to	95	0	0
Sulphate, white	ton	8	10	0	to	10	0	0
Sulphur chloride	ton	42	0	0	to	44	10	0
Sulphur, Flowers	ton	19	0	0	to	19	10	0
Roll	ton	19	0	0	to	19	10	0
Tartar emetic	lb.	0	3	2	to	0	3	4
Tin perchloride, 33%	lb.	0	2	6	to	0	2	7
Perchloride, solid	lb.	0	3	0	to	0	3	3
Protochloride (tin crystals)	lb	0	2	0	to	0	2	1
Zinc chloride, 102 Tw.	ton	22	0	0	to	23	10	0
Chloride, solid, 96-98%	ton	60	0	0	to	65	0	0
Oxide, 99%	ton	82	10	0	to	85	0	0
Oxide, 94-95%	ton	70	0	0	to	72	10	0
Dust, 90%	ton	90	0	0	to	92	10	0
Sulphate	ton	21	10	0	to	23	10	0

Coal Tar Intermediates, &c.

	per	£	s.	d.		£	s.	d.
Alphanaphthol, crude	lb.	0	4	0	to	0	4	3
Alphanaphthol, refined	lb.	0	5	6	to	0	5	9
Alphanaphthylamine	lb.	0	3	9	to	0	4	0
Aniline oil, drums extra	lb.	0	1	8	to	0	1	9
Aniline salts	lb.	0	1	10	to	0	2	0
Anthracene, 85-90%	lb.		—		to		—	
Benzaldehyde (free of chlorine)	lb.	0	5	9	to	0	6	0
Benzidine, base	lb.	0	13	6	to	0	14	0
Benzidine, sulphate	lb.	0	10	6	to	0	11	0
Benzoic acid	lb.	0	5	3	to	0	5	6
Benzoate of soda	lb.	0	5	3	to	0	5	6
Benzyl chloride, technical	lb.	0	2	0	to	0	2	3
Betanaphthol benzoate	lb.	1	6	0	to	1	7	6
Betanaphthol	lb.	0	5	6	to	0	5	9
Betanaphthylamine, technical	lb.	0	11	6	to	0	12	6
Croceine Acid, 100% basis	lb	0	5	0	to	0	6	3
Dichlorbenzol	lb.	0	0	6	to	0	0	7¾
Diethylaniline	lb.	0	7	9	to	0	8	6
Dinitrobenzol	lb.	0	1	4	to	0	1	5
Dinitrochlorbenzol	lb.	0	1	5	to	0	1	6
Dinitronaphthaline	lb.	0	1	6	to	0	1	8
Dinitrotoluol	lb.	0	1	8	to	0	1	9
Dinitrophenol	lb.	0	2	9	to	0	3	0
Dimethylaniline	lb.	0	5	9	to	0	6	0
Diphenylamine	lb.	0	5	0	to	0	5	3
H-Acid	lb.	0	14	6	to	0	15	0
Metaphenylenediamine	lb.	0	5	9	to	0	6	0
Monochlorbenzol	lb.	0	0	10	to	0	1	0
Metanilic Acid	lb.	0	7	6	to	0	8	6
Monosulphonic Acid (2:7)	lb.	0	7	6	to	0	8	0
Naphthionic acid, crude	lb.	0	5	6	to	0	6	0
Naphthionate of Soda	lb.	0	6	0	to	0	6	3
Naphthylamin-di-sulphonic-acid	lb.	0	5	6	to	0	6	6
Nitronaphthaline	lb.	0	1	4	to	0	1	6
Nitrotoluol	lb.	0	1	3	to	0	1	4
Orthoamidophenol, base	lb.	0	18	0	to	1	0	0
Orthodichlorbenzol	lb.	0	1	1	to	0	1	2
Orthotoluidine	lb.	0	2	6	to	0	2	9
Orthonitrotoluol	lb.	0	1	3	to	0	1	4
Para-amidophenol, base	lb.	0	15	0	to	0	16	0
Para-amidophenol, hydrochlor	lb	0	15	6	to	0	16	6
Paradichlorbenzol	lb.	0	0	6	to	0	0	8
Paranitraniline	lb.	0	8	6	to	0	9	0
Paranitrophenol	lb.	0	2	9	to	0	3	0
Paranitrotoluol	lb.	0	5	9	to	0	6	0
Paraphenylenediamine, distilled	lb.	0	13	6	to	0	14	6
Paratoluidine	lb.	0	8	6	to	0	9	6
Phthalic anhydride	lb.	0	4	9	to	0	5	0
R. Salt, 100% basis	lb.	0	4	0	to	0	4	2
Resorcin, technical	lb.	0	11	6	to	0	12	6
Resorcin, pure	lb.	1	2	6	to	1	5	0
Salol	lb.	0	6	9	to	0	7	0
Shaeffer acid, 100% basis	lb.	0	3	6	to	0	3	0
Sulphanilic acid, crude	lb.	0	1	6	to	0	1	7
Tolidine, base	lb.	0	10	6	to	0	11	6
Tolidine, mixture	lb.	0	3	0	to	0	3	6

The following prices are furnished by Messrs. Miles, Mole & Co., Ltd., 101, *Leadenhall Street, London, E.C.*

Metals and Ferro-Alloys

	per	£	s.	d.		£	s.	d.
Aluminium, 98-99%	ton	185	0	0	to	186	0	0
Antimony, English	ton	52	0	0	to	53	0	0
Copper, best selected	ton	106	0	0	to	108	0	0
Ferro Chrome, 60%	ton	42	0	0	to	43	0	0
Manganese, loose	ton	37	0	0	to	38	0	0
Silicon, 45-50%	ton	23	0	0	to	24	0	0
Tungsten, 75-80%	lb.	0	3	3	to	0	3	6
Lead Ingot	ton	37	0	0	to	38	0	0
Lead Sheets	ton	48	0	0	to	49	0	0
Nickel, 98-99%	ton	230	0	0	to	231	0	0
Tin	ton	265	0	0	to	266	0	0
Zinc Sheet	ton	78	0	0	to	80	0	0
Spelter	ton	41	0	0	to	42	0	0

Structural Steel

	per	£	s.	d.		£	s.	d.
Angles and Tees	ton	30	0	0	to	31	0	0
Flats and rounds	ton	28	0	0	to	30	0	0
Joists	ton	24	0	0	to	25	0	0
Plates	ton	25	0	0	to	26	0	0
Rails, heavy	ton	25	0	0	to	26	0	0
Sheets, 24 Gauge	ton	42	0	0	to	43	0	0
Galvd. Corrd. Sheets	ton	—				—		

Alsatian Potash

THE various grades of Alsatian potash are now being supplied in fine condition suitable for the preparation of compound fertilisers. In view of increased freights next year buyers are advised to augment their stocks now. Autumn application is advocated, and as an increased demand may be expected during the next few months the present prices should be considered. Quotations for the past week f.o.r. in bags were approximately as follows :—Sylvinite, 14-16 per cent. (French kainite), £7 13s. 6d. per ton ; sylvinite, 20-22 per cent. (French potash manure salts), £9 13s. 6d. per ton ; sylvinite, 30-32 per cent. (French potash manure salts), £13 13s. 6d. per ton ; muriate of potash, 50 and 60 per cent., £28 5s. per ton.

Mica Shipments from South Africa

THE Ridge Roasting Furnace & Engineering Co., 2, Great Winchester Street, E.C. 2, advise us that mica shipments from South Africa have been resumed and a first parcel has just arrived per s.s. "Nevasa," while other shipments are advised by cable. Considerable quantities are expected at regular intervals.

New Derbyshire Minerals

MR. C. S. GARNETT, of Sheffield University, announced last Saturday the discovery, after a year's research, of the presence in the Peak district of Derbyshire of six or seven minerals not previously known to exist there. Of the new minerals, the two most important are cobalt and manganese ore. Cobalt, a very rare and valuable metal, used in the manufacture of high-speed steel, had previously been found in Cumberland and Cornwall, but only in small deposits. Mr. Garnett found the metal by analysing samples of a blue hydrozincite ; it remains to be proved whether it exists in sufficient quantity to be worked. Of the manganese ore, Mr. Garnett states he has found a large quantity, and its commercial value is certain, for South Russia and India, the chief sources of supply hitherto, have recently failed to fill the demand. The other minerals new to Derbyshire are dealantite, a member of the chlorite group occurring in decomposed lava ; nephrite, a white jade ; cimolote, a white, amorphous, chalk-like silicate of alumina ; utatrite, a dull yellowish-brown amorphous deposit, containing ferric oxide and sulphur trioxide in the proportion of 2 to 1 ; and allophane, in the form of a white powder. Mr. Garnett also found in a disused lead-mine deposits of native sulphur, almost pure.

Chemical Trade Inquiries

The following inquiries, abstracted from the "Board of Trade Journal," have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W.1. British firms may obtain the names and addresses of the inquirers by applying to the Department (quoting the reference number and country), except where otherwise stated.

LOCALITY OF FIRM OR AGENT.	MATERIALS.	REF. NO.
Bombay ...	Dyes ; paints ; alizarine ; aniline colours ; glassware.	338
British West Indies (Trindidad)	Glassware ; druggists' sundries ...	345
Geneva ...	Varnishes	354
Constantinople	Chemicals	—
Turin ...	Chemical products ; cellulose ; caustic soda ; sodium sulphide	—
Copenhagen ...	Soda ash ; glauber salts	—
Cologne ...	Oils for the manufacture of soaps	—

Company News

ENGLISH MARGARINE WORKS (1919.).—An interim dividend has been declared at the rate of 7 per cent., payable on September 29, on the 7 per cent. cumulative participating shares.

BRITISH ALUMINIUM.—A dividend has been declared on the ordinary shares at the rate of 8 per cent. per annum, less tax, for the six months to June 30 last, payable on October 1.

BRITISH GLASS INDUSTRIES.—An interim dividend has been declared of 2s. per share, less tax, on the issued share capital of £3,500,000, payable on September 30 to holders on the register at September 15.

A NEW COMPANY, with a capital of 100,000,000 marks, has been formed in Hamburg with the object of developing the margarine and oil works now in that city, and reviving the production of oil fats in Germany.

CALICO PRINTERS' ASSOCIATION.—Mr. L. B. Lee (Chairman), who presided at the annual meeting on Wednesday, said that if the present level of prices were maintained, it would be necessary for the board to secure additional capital.

AMERICAN CYANAMID.—The report to June last states that operation of the cyanamid plant at Niagara Falls has been at full capacity for the entire year. The two new and improved carbide furnaces, of a capacity in excess of the eight old furnaces which they replace, were completed during May, and from the standpoints of economy and efficiency have fully met expectations. For the past six months the production of ammo-phos, in order to meet trade demands and market conditions, has been confined to a new grade of material containing approximately 20 per cent. ammonia and 20 per cent. available phosphoric acid. The profit and loss account shows a net profit for the year of American Cyanamid Co. of $2,023,695. Add profit of subsidiary company (Amalgamated Phosphate Co.), $71,157 ; combined net profit, $2,094,852 ; deduct reserve for income and excess profits taxes, $335,000 ; licences and patents, proportion written off, $233,975 ; net income, $1,525,877 ; add surplus as at June 30, 1919, $1,723,529 ; and adjustment of reserve for income tax as at June 30, 1919, $70,158, and sundry income credits affecting period prior to June 30, 1919, less losses on dismantled plant, $32,369—total, $3,351,933 ; deduct dividends declared on preferred stock (to June 30, 1920), $959,304 ; surplus as at June 30, 1920, $2,392,629.

Major & Co.

Major & Co. are this week inviting application for 100,000 8½ per cent. cumulative preference shares of £1 each at par, and 60,000 ordinary shares of £1 each at par. The main business of the company, which was established in 1857 by the late Mr. J. C. Major, is distilling and refining coal tar and petroleum products. It also manufactures tar for roads, solvent naphthas, motor spirit, naphthalene, asphaltic varnishes, carbon for electrodes, fuel oils, creosote, carbolic acid, refined petroleum products, selected coal tar colours.

Major & Co. own and manufacture Solignum, the well-known wood preservative, used in most countries of the world as a preventive of decay in timber and as a cure for various insect and fungoid pests. The objects of the present issue are to pay off existing loans and provide funds for the completion of extensions now in hand and for further working capital.

The company owns freehold works at Hull and Wolverhampton, and long leaseholds of works at Chesterton and Dagenham. It has recently acquired freehold premises and works at Saltney. Other freehold works at Hull and at Four Ashes, near Wolverhampton, and leasehold works at Stockton-on-Tees, are owned by the following subsidiary companies, in which Major & Co. hold 95 per cent. or upwards of the issued capital : Tar Slag, Ltd., which manufactures tarred slags for roads ; The Vulcan Chemical Co., Ltd., which manufactures disinfectants, sheep dips, &c. : The Four Ashes Manufacturing Co., Ltd., which, from one of the parent company's products, is now beginning the manufacture of carbon black ; The Paragon Rubber Co., Ltd., which manufactures ebonite and other insulating materials.

The company has tank storage for nearly 7,00,000 gallons of liquid products, and controls tank wagons with a carrying capacity of over 250,000 gallons.

No part of this issue has been underwritten.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for any errors that may occur.

London Gazette

Bankruptcy Information

WALKER, FREDERICK, 65, York Road, Southend-on-Sea, Essex. Assistant Manager to a Dye and Chemical Company. September 10. First meeting September 24, 12 noon, Bankruptcy Buildings, Carey Street, London, W.C.2. Public examination November 16, 11 a.m., Bankruptcy Buildings, Carey Street, W.C.2.

Partnership Dissolved

LEWIS, WALTER JOHN AND PAGE, FREDERICK CLEMENT, Chemists and Pharmacists, 3, Hinckley Road, Leicester, under the style of Lewis & Page, by mutual consent as from August 1.

Notice of Intended Dividend

DRIVER, JOHN GEORGE, 70 and 72, St. Mary's Road, Garston, Liverpool. Chemist and Druggist. September 29. Trustee, E. D. Symond, Official Receiver, 11, Dale Street, Liverpool.

Company Winding Up Voluntarily

UNION ZINC MINING CO., LTD.—A meeting of creditors will be held at 20, Lawrence Lane, London, E.C.2, on Friday, September 17, at 12 noon. A. N. Stockdale, Liquidator.

Mortgages and Charges

[*NOTE.—The Companies Consolidation Act, of 1908, provides that every Mortgage or Charge, as described therein, created after July 1, 1908, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every Company shall, in making its Annual Summary, specify the total amount of debts due from the Company in respect of all Mortgages or Charges which would, if created after July 1, 1908, require registration. The following Mortgages and Charges have been so registered. In each case the total debt, as specified, in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced since such date.*]

SAND, GLASS & FOUNDRY MATERIALS (AMALGAMATED), LTD., Doncaster.—Registered September 2 (by order on terms), £2,000 mortgage, to B. P. Coulson, Brauncewell; charged on land at Heck.

Satisfaction

BRITISH VEGETABLE OIL EXTRACTION CORPORATION, LTD., London, E.C.—Satisfactions registered September 8, £17,000, registered March 14, 1916; £80,000, registered April 3, 1918; £150,000, registered September 23, 1918; £100,000 (not ex.), registered January 21, 1919; all moneys due, &c., registered February 13, 1919; and £25,000 (not ex.), registered August 20, 1919.

Bill of Sale

[*The undermentioned information is from the Officia Registry. It includes Bills of Sale registered under the Act of 1882 and under the Act of 1878. Both kinds require re-registration every five years. Up to the date the information was obtained it was registered as given below; but payment may have been made in some of the cases, although no notice had been entered on the Register.*]

BURGESS, H. MORTON, 47, Norwood Road, Southport, Fertiliser Manufacturer. Filed September 8. £100.

New Companies Registered

The following have been prepared for us by Jordan & Sons, Ltd., company registration agents, 116 and 117, Chancery Lane, London, W.C.:—

MARRIS & MORTON, LTD., chemists and druggists. Nominal capital £2,000 in 2,000 shares of £1 each. Directors: H. C. Morton, G. English, C. R. Morton, and F. Moore. Qualification of directors, one share.

PENTOWAN GLASS BOTTLE CO., LTD., Pentowan Works, Hayle, Cornwall, manufacturers and dealers in glass and glass bottles. Nominal capital, £8,000 in 8,000 shares of £1 each. Minimum subscription, seven shares. Directors: G. W. Slater, T. V. Gudge, J. T. Hunnalls, and P. B. Lello. Qualification of directors, £200.

BRITISH EQUATORIAL OIL CO., LTD., Salisbury House, London Wall, E.C. Petroleum and other mineral oils. Nominal capital, £200,000 in 200,000 shares of £1 each. Directors to be appointed by subscribers. Subscribers: The National Mining Corporation, Ltd.; The MexicanCorporation, Ltd.; D'Arcy Exploration Co., Ltd.; Scottish-American Oil and Transport Co., Ltd.

THELWALL RUBBER ESTATES, LTD., 3 and 4 Great Winchester Street, E.C. 2. Planters and dealers in rubber, gutta percha, and other gums. Nominal capital, £50,000 in 50,000 shares of £1 each. Minimum subscription, seven shares. Directors: Sir P. Denshan, K.B.E., R. Goold, R. Holden, J. G. Nicolson, and K. Shephard. Qualification of directors, 100 shares. Remuneration of directors, £50 each; chairman, £75.

CERESCO, LTD., County Bank Chambers, Blackburn, chemical manufacturers. Nominal capital, £20,000 in 20,000 shares of £1 each. Directors: J. H. Almond, T. Blackburn, E. Ley, P. Ley, E. Walmsley, and L. Collinson. Qualification of directors, £1,000. Remuneration of directors, £600 to be divided.

CHEMICALS AND MINERALS, LTD., 39, Central Chambers, Market Place, Doncaster. Oil and general importers and merchants. Nominal capital, £1,000 in 1,000 shares of £1 each. Directors to be appointed by subscribers. Qualification of directors, one share.

DONCASTER GLASS CO., LTD., Glass manufacturers and merchants. Nominal capital, £10,000 in 10,000 shares of £1 each. Directors: M. Asquith (chairman) and H. Bunniss. Qualification of directors, £50.

SOAPS, LTD., 55, Newhall Street, Birmingham, Soap manufacturers. Nominal capital, £5,000 in 5,000 shares of £1 each. Directors to be appointed by subscribers. Qualification of directors, £100.

AINSLIE WALKER LABORATORIES, LTD., 14, Bride Lane, E.C.4.—Research and manufacturing chemists. Nominal capital £6,000 in 6,000 shares of £1 each. Directors: J. T. A. Walker (managing director), L. G. Lane, H. Becker, W. Weston. Qualification of directors, one share.

COMMERCIAL PRODUCTS SYNDICATE, LTD., 39, Victoria Street, S.W.—Manufacturers of artificial fuel, &c. Nominal capital £900 in 300 "A" shares of £1, and 600 "B" shares of £1 each. Directors: R. Brown, R. W. Baxter, R. Carter, G. Gosner, W. G. White. Qualification of directors, £100.

Benn Brothers Journals

Some Features of the Current Issues

AERONAUTICS.

"The Aeroplane Tests and Running Costs"; "Development in Wing Design," by Douglas Shaw; "Soaring Flight in Guinea."

THE CABINET MAKER.

"Modern American Tables"; "How Retail Furnishers Advertise"; "Seats for Factory and Workshop Operatives: Home Office Recommendation."

THE ELECTRICIAN.

"Crawling of Induction Motors," by L. H. Carr; "Pulverized Coal in the Power Station," by L. C. Harvey, and E. E. Noble; Description of Electrical Exhibits at the Machine Tool Exhibition.

THE FRUIT-GROWER.

"Autumn Planting"; "Railway Rates and Manures"; "Market Varieties of Apples" (illustrated).

THE GAS WORLD.

"Station Gas Meters," by F. R. Parsons; "The Gas Regulation Act"; "Coin Meters in Holland."

THE HARDWARE TRADE JOURNAL.

"Independent Gas Lighting and Heating Systems"; "Hints on Retail Organization"; "Labour Saving in the Foundry," by Joseph Horner.

WAYS AND MEANS.

"Facts Concerning Coal," by E. G. Brunker; "A Colonial Romance," by John H Harris; "Works Schools: American Experience," by J. George Frederick.